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Communications—Electronics—Photography

JANUARY 1958

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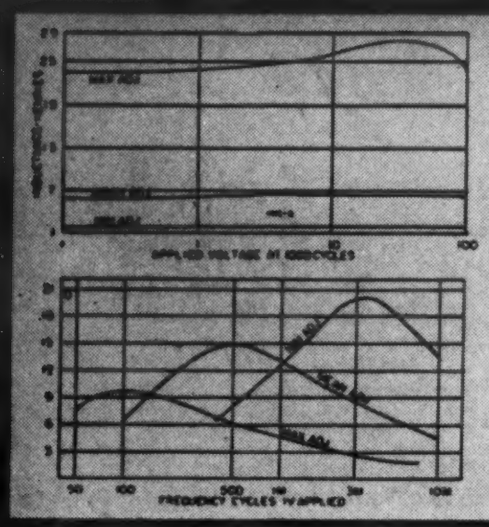
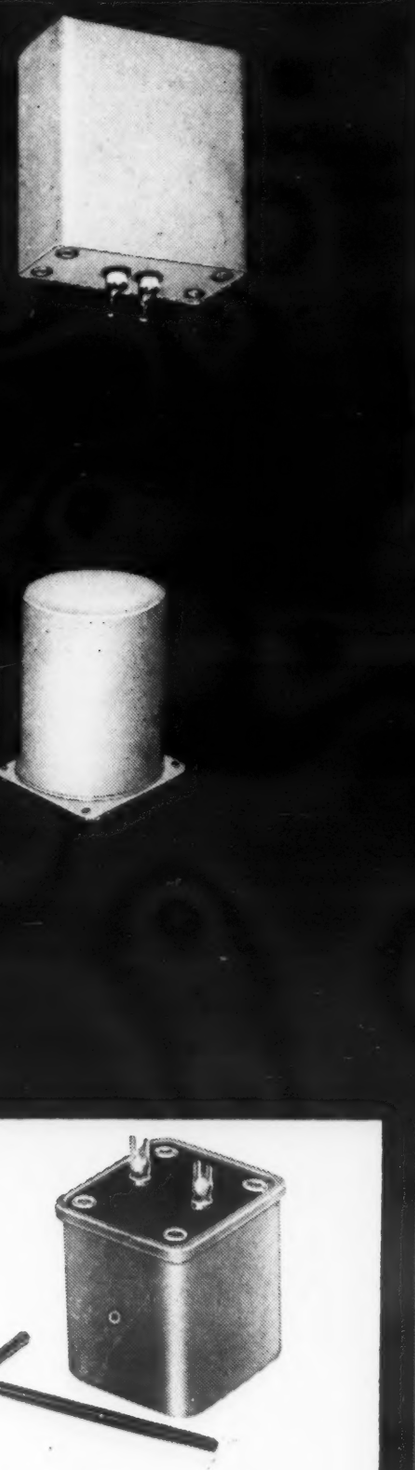
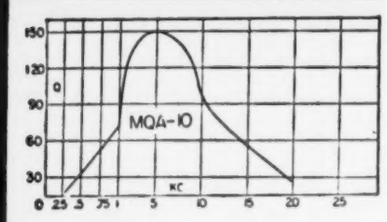


Type No.	Min. Hys.	Mean Hys.	Max. Hys.
HVC-1	.002	.006	.02
HVC-2	.005	.015	.05
HVC-3	.011	.040	.11
HVC-4	.03	.1	.3
HVC-5	.07	.25	.7
HVC-6	.2	.6	2
HVC-7	.5	1.5	5
HVC-8	1.1	4.0	11
HVC-9	3.0	10	30
HVC-10	7.0	25	70
HVC-11	20	60	200
HVC-12	50	150	500





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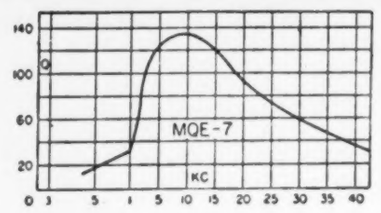
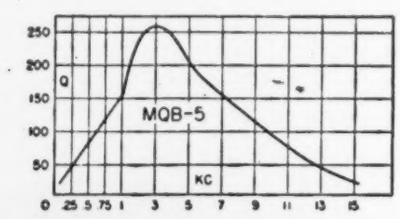


MQE
15 stock values from 7 Mhy. to 2.8 Hy.



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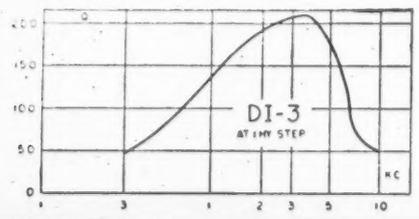
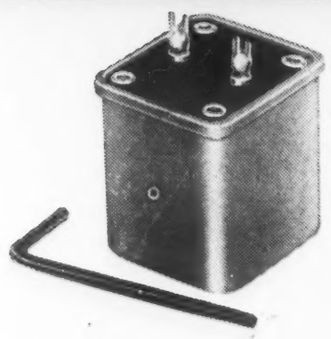
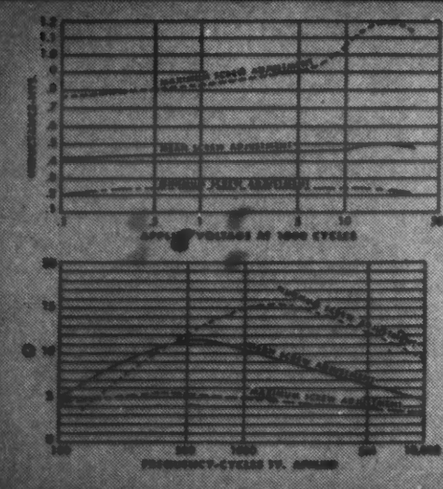


DI-1 Ten 10 Mhy. steps.
DI-2 Ten 100 Mhy. steps.
DI-3 Ten 1 Hy. steps.
DI-4 Ten 10 Hy. steps.



VIC case structure

Length	Width	Height	Oz.
1-1/4	1-11/32	1-7/16	5-1/2



Type	Mean Hys.	Type	Mean Hys.
VIC-1	.0085	VIC-12	1.3
VIC-2	.013	VIC-13	2.2
VIC-3	.021	VIC-14	3.4
VIC-4	.034	VIC-15	5.4
VIC-5	.053	VIC-16	8.5
VIC-6	.084	VIC-17	13.
VIC-7	.13	VIC-18	21.
VIC-8	.21	VIC-19	33.
VIC-9	.34	VIC-20	52.
VIC-10	.54	VIC-21	83.
VIC-11	.85	VIC-22	130.

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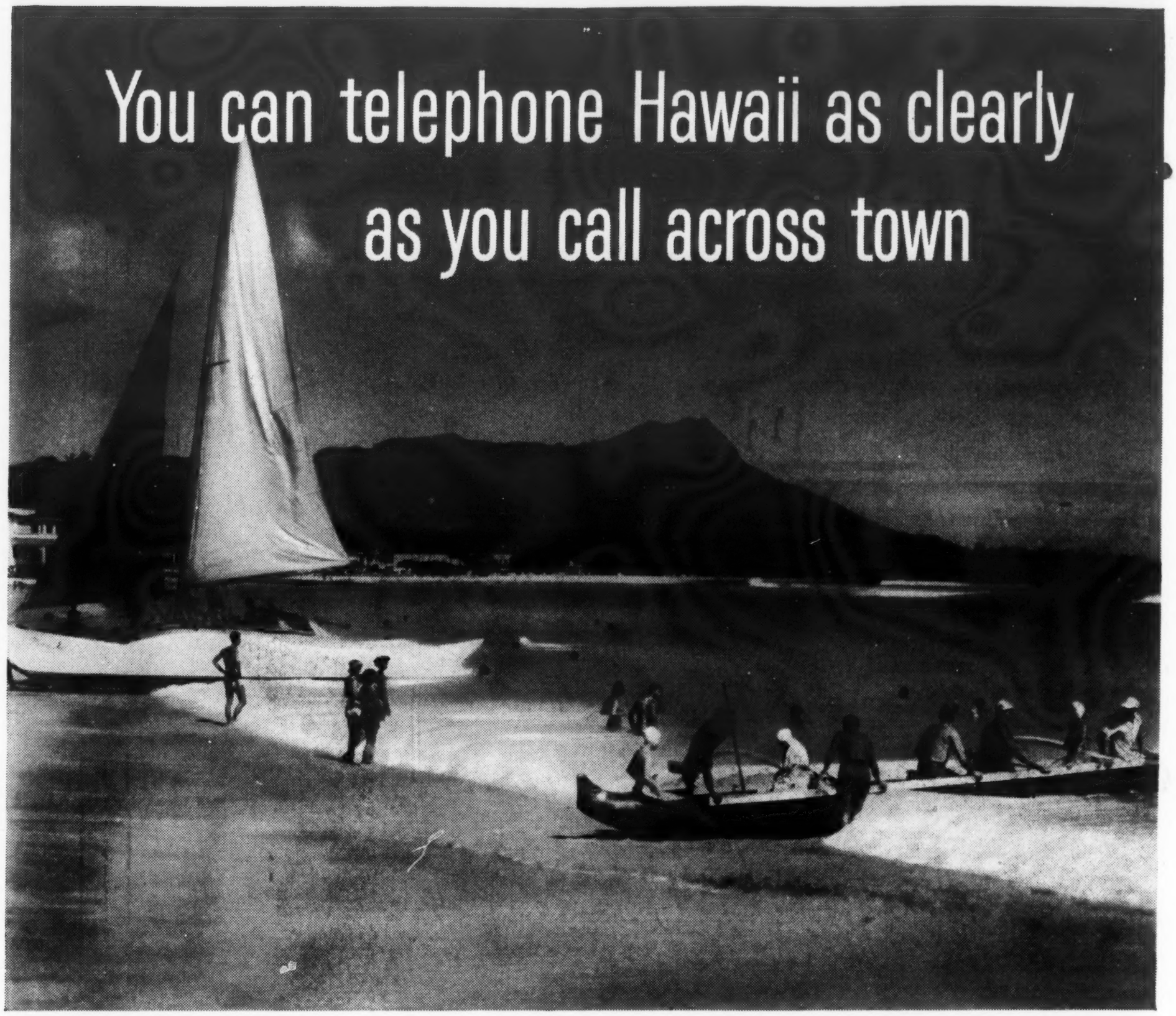

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SIGNAL is published monthly by the Armed Forces Communications and Electronics Association at 1624 Eye St., N. W., Washington 6, D. C. Entered as Second-class matter at Post Office, Washington, D. C., September 6, 1946, under Act of March 3, 1879. Additional entry at Baltimore, Maryland.

Subscription rate to members of the AFCEA: 1 year (12 issues), $5.00. To non-members, $7.00. To foreign post offices, $8.00. Single copies, $1.00 each. All rights reserved. Copyright 1958 by Armed Forces Communications and Electronics Association. Reproduction in whole or in part prohibited except by permission of the publisher. Printed in U.S.A. by Monumental Printing Co. at Baltimore, Md. The publisher assumes no responsibility for return of unsolicited manuscripts or art. When sending change of address, please list the old and the new address, and allow 3 weeks for delivery of first copy.

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SIGNAL

Communications-Electronics-Photography

Journal of the Armed Forces Communications and Electronics Association

VOLUME XII JANUARY 1958 NUMBER 5

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Photo credit page 24: American Forests Magazine

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W. J. Baird
Editor

WE ALL REALIZE that this is truly a changing age, an age marked by technological progress where new breakthroughs are doing more to benefit our standards of living than at any other time since the invention of the steam engine. But, in this changing age of social and industrial revolution with its prodigious effort for space control, we are prone not to take cognizance of the fact that the general field of resources of the Nation—human, material and economic—and their mobilization in peacetime or emergency becomes profoundly meaningful. An understanding of the mobilization of all our national resources to support our national objectives, as symbolized by the "5 Big M's," was never before as important as it is today.

The part played by the "5 Big M's"—Money, Manpower, Materials, Manufacturing and Management — in national security and their interrelationship with the military, psychological, economic and educational factors is a vital area which must be explored continuously and understood fully by all. It is especially true in these areas as they relate to future technological progress and the fulfillment of our national objectives.

This, then, is the background and thinking which has prompted AFCEA to publish in January 1958, and throughout the new year, a series of articles relating to these important segments of our economy in its official magazine, SIGNAL. These are the areas in which the grass roots of communications and electronics are firmly planted—areas which not only affect our security, but also our foreign policy. The stockpiling of communications, electronics and photographic information, as it relates to the 5 M's, makes SIGNAL a dependable storehouse for factual knowledge.

The fifteen feature articles which appear in this issue are the first in this series. They should provide interesting reading over a broad area and, at the same time, convey the reasoning for our approach to this editorial undertaking.

Power Resources

There are many reasons why this Nation of ours has risen to a position of world leadership. From the very beginning we have been blessed with certain geographical advantages—(a) a temperate climate which has made us an industrious people, (b) the vast network of inland waterways and natural harbors, together with other communication systems which have encouraged our economic growth and (c) a more than adequate share of fertile, tillable soil which has provided us with a breadbasket of plenty. Aside from these geographical blessings, our form of government and our free enterprise system have permitted the rapid attainment of our industrial might and our technological and scientific development.

I am sure that you can think of other equally important factors which have contributed to our position of national power. But, at the very foundation of our power structure are two factors on which our whole posture depends. I have reference to our human resources and to our material or natural resources. Our American population figure will approach the 180 million mark in the not too distant future. From an economic mobilization standpoint, we are primarily interested in the amount of goods and services this population can produce. From a military standpoint, we are interested in the availability of trained man power for the protection of our American way of life. From a logistical viewpoint, we are interested in the support of these two concepts. Be this

as it may, as important as population numbers are, we all recognize that we cannot match our probable enemy in that department. Much of our human resource strength lies in the health of our population, in the will of the people to fight and work for their heritage, in the skills we have acquired and in our technological achievements. When you weigh all of these together, they spell productivity —productivity of the individual.

Changing Times

In 1858, the American worker combined considerable human and animal effort with but little machine labor over a long period of time to produce only a small quantity of goods and services. By 1908, with the industrial age on the horizon, productivity started on the up-swing so that in 1958, with machine labor dominating production, the average American will enjoy over three times the quantity of goods and services he had in 1908—and this with a decrease in workweek to 40 hours a week at the present time, as compared to 54 hours in 1908. In a nutshell, this represents the American standard of living. By the year of 2008, even with labor's idea of a reduced workweek to 30 hours plus the electronic gadgets for automation, this productivity should continue upward. The productivity which we have gained through the application of science and technology is truly the key to our human resource strength, and enables us to compete with more populous nations.

Raw Materials Critical

This leads to the subject of raw material resources. This industrialized economy of ours, as reflected in the growth of machine labor, is a mechanized giant with a Gargantuan appetite for raw materials. You have but to reflect for a moment to realize the role which raw materials play in both our peacetime and wartime economies.

The electric refrigerator, the deepfreeze, radio, TV, the clothes washer and dryer, electric toaster, the automobile, radar, electronic computers, microwave transmission, etc. — many of these are no longer conveniences, but are now considered necessities to our economic structure. They require raw materials.

Then, too, weapons of war are far advanced from the old bow and arrow days; our aircraft, ships, tanks, missiles, together with transportation, communications and other services—all these now demand a tremendous quantity of raw materials to feed the machines which produce them.

It is astounding to realize that the quantity of most metals and mineral fuels used by the U.S. since World War I exceeds that quantity consumed by the whole world in all the years prior to World War I. In fact, the U.S. has consumed, since 1900, 75% of all the coal and 97% of all the petroleum consumed by the world since the beginning of recorded history!

So today, we find ourselves not as a "have all" nation but as a "need more" one—a nation whose raw material needs can no longer be met from domestic sources. With 6% plus of the world's population and 8% of the world's land area, we are consuming 50% plus of the world's annual materials production.

Today, there are approximately 80 materials considered strategic and critical to the U.S.—materials not domestically available in sufficient quantity or quality to meet expected wartime requirements.

We are presently dependent on areas all over the world for considerable quantities of these materials. We rely on imports for more than 90% of our current consumption of the following materials: tin, nickel, chrome, mica sheet, asbestos, mercury and cobalt; over 75% of our consumption of tungsten, bauxite, and antimony also comes from foreign areas; over 50% of our lead and quartz, and over 33% of our zinc and fluorspar and over 25% of our copper.

Now the fact that the position of our natural resources isn't as good as we would like is not in itself too important. What is important is our position compared with that of the Soviet Union.

Unfortunately, little comfort can be gained from an examination of the Soviet position. Studies show the Soviet Union is wealthy in natural resources. She is considered to have more iron than we do; she ranks 2nd to us in coal; she has tremendous petroleum reserves, and she has ample manganese—so vital for the basic steel industry, yet so lacking in the quantity we need.

And it might be emphasized that with each new Soviet territorial conquest, not only does she improve the position of her own natural resources, but she definitely dents our sources of supply.

All this, then, points up the problem we face today — how to insure a supply of raw materials for both an expanding peacetime economy, and for a war emergency.

Stockpiling of Time

Certainly you don't have to be a genius to conclude that we cannot stake our security

on getting materials from areas which probably would be denied us in wartime.

World War II has some lessons worth remembering — during the first 6 to 8 months of World War II, German subs sank about 90% of our ships carrying chromite and manganese from Africa, and 85% of our ships carrying bauxite from the northern coast of South America.

Even if we could—and the chances are we can—lick any future shipping losses, isn't it possible that many of these foreign sources would be denied us for political or other reasons?

How then can we assure ourselves of these materials when we need them? Part of the answer is in stockpiling. The Stockpiling Act of 1946 provides for the stockpiling of those approximately 80 strategic and critical materials which I mentioned earlier. Although space only allows here a brief mention of the Government's stockpile program, it will however be covered in more detail in a subsequent issue of SIGNAL.

But, before leaving this subject, it is important to add that a stockpile is more than an accumulation of materials. Figuratively speaking, we are also stockpiling man hours of labor and shipping docks, along with all kinds of communications, electronics, transportation and other vital equipment. We are stockpiling all these in the sense that we are pre-using them before the emergency (as we import and stock the raw materials), thus making them available for other uses after the emergency starts.

And perhaps as important as anything, we are stockpiling time— we won't have to wait for imported materials to start production moving.

Mining Considerations

Now we all appreciate the necessity for having these stocks on hand, but let us not forget that a going domestic mining industry is also an essential part of the whole package. And this poses a controversial question —whether or not these domestic mining industries should be given economic protection in the form of tariffs or subsidies.

In many of these strategic and critical materials, our domestic mining industries are finding it extremely difficult to compete with high-grade foreign ores and with inexpensive foreign labor.

On the other hand, there is a powerful school of thought that such economic protection is contrary to the principle of obtaining materials according to least cost—a practice which its advocates say is necessary if we as a Nation are going to continue our economic expansion and if we are to maintain our position of leadership in world affairs.

In addition to the economic considerations, there are also political considerations which we cannot overlook.

The Economic Issue

Is the destiny of our Nation inalterably bound with that of other Free World countries? Judging from our political and military alliances (NATO? SEATO? ANZUS? Rio Pact? etc.), it appears that this is a struggle between the Free World as a whole and the Soviet Bloc. Furthermore, we cannot overlook the fact that our country has abandoned its traditional political isolationism.

If that's the case then, would it be politically feasible for us to adopt a policy of economic self-sufficiency—a policy which would have a serious effect on the already weak economics of many Free World countries? This is what our political and military alliances are trying to prevent in this fight against Communism!

We must keep in mind that the international struggle today is not solely that of a military threat, nor just a battle for the control of men's minds, but that it is also an economic struggle. In fact, there is a long line of experts who feel that the greatest danger is not that of military action, but is one of long-range economic considerations.

Question of Technology

And yet, in spite of the seriousness of these considerations, there are still those who feel that we have no raw materials problem—that American ingenuity and technology will always find a solution.

Admittedly, technology has made great contributions in the past to materials supply—new methods of discovery, new mining and processing techniques, substitutes for scarce materials.

But can we *count* on that? . . . . . Instead of alleviating the materials problem, future technology might very well create new products and uses which would have the net result of adding to the demand for already scarce materials.

It is true, we Americans do seem to have a blind faith in technology. But we can't take refuge in the hope that today's problems will somehow be averted—the stakes are too high. *We may never have to fight potential aggressors but, still, we must be prepared.*

SIGNAL'S AUTHORS

AS THEY APPEAR:

James D. Secrest, (page 10) Executive Vice President of Electronic Industries Association since 1952, spent some 20 years in newspaper and public relations work before joining EIA. During World War II, he was associated with the Information Division of the Office For Emergency Management and the Office of War Information. In 1945, he became Director of Public Relations for the Radio Manufacturers Association. In 1950, Mr. Secrest was elected General Manager of the EIA, then RETMA. He is a graduate of Duke University.

J. N. Dyer, A. J. Jensen, C. L. Rouault, and **R. F. Schulz,** (page 12) were the members of a four-man team of electronic engineers who made a ten-day inspection tour of industry centers in Moscow and Leningrad under the auspices of the U. S. State Department. The group visited radio and television broadcasting stations, research institutes and production factories. They were invited to the U.S.S.R. by the Soviet Ministry of the Radio Industry and by the Popov Society, the Russian equivalent of our Institute of Radio Engineers.

Major General Alvin L. Pachynski, USAF, (page 18) has been Director of Communications-Electronics, USAF, since June 1956. He was graduated from the United States Military Academy and received his M.S. degree from Yale University. During World War II, General Pachynski served as Signal Officer, 5th Air Force, Southwest Pacific, and as Air Communications Officer, Far East Forces.

Senator Leverett Saltonstall, (page 20) having served three consecutive terms as Governor of Massachusetts, was elected to the U. S. Senate in 1944 and has served in this capacity ever since. Together with his duties as Chairman of the Republican Conference, his present Senate committee assignments include: Armed Services, Appropriations, Small Business and Republican Policy. The Harvard-trained Senator holds 12 honorary degrees and has been associated with national legislation of importance. He served in the Military during World War I and is a recognized athlete, a born leader and a distinguished statesman.

General Thomas S. Power, USAF, (page 24) after serving in Italy in World War II, led and directed from Guam the first large-scale fire bomb raid on Tokyo on March 9, 1945. During the atomic bomb attacks on Hiroshima and Nagasaki, he served on General Spaatz's staff as Deputy Chief for Operations. Following various other assignments of importance, General Power became Commander in Chief of the Strategic Air Command on July 1, 1957 with promotion to four-star rank. He has been awarded many military decorations.

Walter P. Marshall, (page 28) President of Western Union Telegraph Company since 1948, is also a director and member of the executive committees of American Broadcasting-Paramount Theatres, Inc., and of the American Express Company. Under Mr. Marshall's dynamic leadership the improvement in Western Union's financial condition has kept pace with technological progress, attaining world leadership in the facsimile field. Mr. Marshall is a member of several clubs and societies and attended the City College of N. Y. and Columbia University.

Dr. Malcolm H. Hebb, (page 32) joined General Electric Company in 1949 and is presently Manager of the General Physics Research Department. His academic background includes a Bachelor's degree from University of British Columbia, graduate work at Wisconsin and a Ph.D. from Harvard. Mr. Hebb specializes in the field of theoretical solid-state physics.

Donald C. Power, (page 34) was elected President of General Telephone Corporation in 1951, having previously been a Director of the company and its Ohio subsidiary, as well as the Rate Counsel for the General Telephone System. He is a director of some 22 companies. Mr. Power received his LL.B. degree from Ohio State University. Since 1926 he has maintained law offices in Columbus, Ohio. He is one of the Nation's dynamic leaders and has held many public service positions.

Edmond H. Leavey, (page 37) President of International Telephone and Telegraph Corporation, had extensive experience in both the operational and administrative fields of engineering prior to joining the corporation. A graduate of West Point, General Leavey served his country with distinction and was Chief of the Logistics Division of Supreme Headquarters of the Allied Powers in Europe (SHAPE) before his retirement in 1952 from the Army with the rank of Major General. He is a registered professional engineer in civil and industrial engineering, State of Texas.

J. A. Morton, (page 40) joined the Bell Telephone Laboratories in 1936 after attending the University of Michigan where he received his Master's degree. In 1953, as Director of Transistor Development, he was in charge of all development of semi-conductor devices. He has been Director of Device Development for the Laboratories since June 1955.

Ellery W. Stone, (page 44) President of American Cable & Radio Corp., and author of *Elements of Radio Communications,* has an outstanding record of service as an administrator in the field of radio engineering. Serving in positions of military importance in World War I and World War II, he was decorated several times for superior service. A member of the U. S. Naval Reserve, Admiral Stone also served as Deputy President and Chief Commander of Allied Control Communications, Italy.

James M. Bridges, (page 45) Director of Electronics, Office of the Assistant Secretary of Defense (Research & Engineering), served extensively in the Navy Bureau of Ordnance —first as Head of Radar Research and Development and then as Chief Engineer for Electronics. He was appointed to his present post in 1955. Mr. Bridges is also a senior member of I.R.E. and Chairman of the Joint Coordinating Committee on Electronics and the Advisory Group on Reliability of Electronic Equipment. Mr. Bridges received his E.E. degree from the University of Maine and is a member and director of AFCEA's Washington Chapter.

Arthur L. Malcarney, (page 49) Executive Vice President and General Manager, Defense Electronic Products, Radio Corporation of America, has been with RCA since 1933. He is a graduate of the advanced management course of Harvard School of Business Administration. Mr. Malcarney has served in various capacities with RCA, becoming Manager of Production, Engineering Products Division in 1953. Prior to his election as Vice President, he served as Manager of Commercial Electronic Products.

Frank Smith, (page 53) SIGNAL's Photo News Editor, is a photographic engineer, Technical Operations, Photo Branch, U. S. Army Signal Corps Engineering Laboratories, Ft. Monmouth, New Jersey, currently working on research and development of photographic equipment. He is a member of AFCEA and the Society of Photographic Scientists and Engineers, and has authored several technical photographic papers.

Ray E. Meyers, (page 62) is Manager of Radio Operations, Lockheed Aircraft Corporation (California Division). Mr. Meyers is also AFCEA's regional vice president for Region F, a Naval Reserve Commander and active in community affairs.

Gen. Power

Mr. Marshall

Dr. Hebb

Mr. Leavey

Mr. Power

EIA EVALUATES

the electronics industry for 1958

IT HAS BECOME A TRITE COMMENTARY to say that the electronics industry is the "fastest growing" of our many industrial enterprises. Far less clear is the answer to the question: What is the electronics industry? Once over that hurdle, everyone agrees it has a bright future.

The electronics industry, while an outgrowth of the pre-war radio industry, was born during World War II. However, its post-war growth was retarded when military budgets were cut drastically after V-J Day. Until the outbreak of Korean hostilities in 1950, most of the industry reverted to radio —and later turned to TV—as its major business.

While World War II requirements for electronic equipment and components were relatively modest compared with today's military demands, they did exceed the pre-war industry's capacity. As a result, many radio and component manufacturers expanded quickly, and many non-radio companies entered the field. At the war's end, many of the latter returned to their pre-war business, and some war-built plants were closed.

Korea and the concurrent resurgence of a national mobilization program changed the situation almost overnight. In 1950 military procurement of electronic equipment rose to $500 million although the Korean War was only six months old. When the truce came in 1953 electronic purchases of the Armed Services had reached an annual rate of $2.5 billion. With some variation, this level prevailed until 1957 when expenditures jumped to $3.5 billion.

The Korean outbreak marked the beginning of a change in the composition of the electronics industry (or the electronic industries, if you prefer) and of its members. Except during World War II, the production of entertainment type receivers for the home accounted for most of the industry's revenue before 1950. Then the output of receivers began leveling off in units manufactured and declined in both average price and in the aggregate percentage of the industry's dollar volume. Between 1950 and 1957 the home entertainment business dropped from 58 to 21 percent of the factory value of electronic products, while the military share rose from 20 to about 50 percent.

This change was not effected without some far-reaching upheavals in the industry itself. Some of these are still going on. Many old line companies rode with the tide and their volume of sales and products multiplied. Others shifted from the home entertainment to the less competitive military-industrial field. A sizeable number disappeared via either sales, mergers or bankruptcies.

Before World War II there were 50 odd receiver manufacturers and about 150 makers of parts and other accessories and equipment. Since 1950 estimates of the number of electronic manufacturers — of wide variance in capacity—have ranged as high as 4,000 although the past year no doubt reduced this total by one means or another.

The EIA Marketing Data Department's tabulations indicate that the industry's dollar volume in 1957 reached a new high of $7.2 billion—an increase of $1.3 billion over 1956. These factory sales (in billions) break down as: consumer products, $1.5; military products, $3.5; industrial products, $1.3 and replacement parts $.9. When revenue from distribution, servicing, and broadcasting are added, the 1957 total becomes $13.5 billion.

What of the future? It is doubtful that even one of the gigantic computers of today could come up with an unchallenged answer because of the many variables involving economics, international diplomacy, and research and development. However, a few broad generalizations and trends are apparent.

Statistically speaking, EIA's guess-estimates are that factory sales will rise another $3.5 billion and revenue from all sources will total $21.5 billion by 1966.

We are only on the threshold of the electronic era. The ceiling on electronics research is unlimited. There is every indication that electronics will bring about as great a revolution in our manner of living as electricity and the automobile have done in past generations.

Already, radio and television have changed the pattern of our home life. push button warfare on earth. Sputniks, space platforms and spaceships not only will rely heavily on radio communications and electronic controls, but they doubtless will take television far beyond the fireside to bring in live pictures of the earth, the sun and the moon from vantage points heretofore unavailable.

The term "automation" has become a household word, and perhaps both its present applications and future potential have been exaggerated. However, the trend toward more and more automatic processes in industry is apparent, and electronic controls are its basic elements. Despite some falterings, this trend is expected to continue, and automation processes will provide a substantial market for the electronics industry.

Computing and data processing systems likewise are popularly known but less well understood. Only recently have they reached a size and price which make them attractive to business establishments as well as to Government and large industrial concerns. It seems likely that this popularization will continue.

A dominant characteristic of the electronics industry today is its extension into so many phases of our ecomonic and personal life. This creates some complexities. The electronics industry is becoming increasingly harder to define or to isolate from other industries such as aircraft, office equipment, and automotive. Its very ubiquitousness threatens the electronics industry with anonymity.

A recent experiment in which the principles of radar were applied to restoring some measure of light detection to a blind person is indicative of the unlimited possibilities of electronics in man's unrelating efforts to master his environment and counter his handicaps. The electronic microscope, which is far less experimental, already is opening new vistas in medical research. Increasing uses of diathermy machines, electro cardiographs, and electronic X-rays are indicative of other electronic invasions into the medical field.

The metal products industry is finding many adaptations of electronics in testing metals, ultrasonic cleaning and automatic controls. Food processing plants are also relying on electronic devices in growing numbers.

As an example of the way in which the electronics industry is tending to merge with other industries is the transistorization of nuclear control equipment. This process is expected to bring about reductions in size and power consumption of reactor systems and lower maintenance and operating costs.

The application of electronic controls to traffic problems that plague so many cities and highways today is still in an experimental stage. However, the possibilities are great as the American Automobile Association has recognized. Electronic equipment which will coordinate all traffic signals from a central point, clear thoroughfares for emergencies, and smooth out peak traffic loads has been developed. An electronic highway system which promises to minimize auto accidents on the high speed turnpikes of the future has been tested successfully. In this test automatic signals on the dashboard tell the driver when to stop or slow down to avoid a collision. While perhaps more distant, the advertising copy writer's dream of a family car in which electronics takes over the driving on the super highway is not unrealistic.

Although radio and TV may have lost the glamour of youth, they are by no means stagnant. A trend toward thinner and thinner cathode ray tubes —with the TV picture on the wall as the ultimate—TV color, and multiple set homes promise renewed vitality. Closed circuit TV is opening new markets in the schools and other industries. Numerous technical improvements in sound reproduction already have brought about a revival in public interest in the radio and phonograph.

The only apparent threat to electronic progress during the next decade is the limitation on spectrum space. However, this is partly man-made. EIA believes this space can be expanded through utilization of technological improvements if the Government is willing to review and revise the present frequency allocations, both to Government and non-Government users, in the light of today's needs and technical capabilities.

Aside from the technical aspects, the future of the electronics industry depends to a large degree on its ability to adapt itself to changing circumstances. Already, it is shrugging off the rugged individualism of its youth and learning to work with Government and other industries. Never dependent on Government subsidy, it must avoid an over-balance of military business. While attractive to investors, it must retain its individuality in the face of mergers and corporate diversification. Its record for enterprise and stamina indicates it will be successful and will emerge stronger than in its earlier and simpler days.

by James D. Secrest • Executive Vice President • Electronic Industries Association

Electronics—allied with nuclear power —has revolutionized the armaments of modern warfare. Significantly, the ratio of electronic equipment and component purchases to total miltary procurement has risen from about 10% in 1950 to 23% in 1957.

It does not require a crystal ball to foresee that electronics will become even more essential as man probes outer space and simultaneously prepares for

ELECTRONICS IN THE USSR

EVERY VISITOR TO THE SOVIET UNION IS ASKED ON HIS return to the U.S.A. one question that is very difficult to answer. The question is: "How does Russian progress in science and technology compare with ours?" The fact that the question is invariably asked seems to indicate that the American public is aware of the fast progress that is being made in the U.S.S.R. Our group of four U. S. engineers was very impressed by the evidences of progress that we saw in Russia. However, the question mentioned above can hardly be answered with any certainty even by experts who have access to all available

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information on the Soviet Union. The best that the visitor can do is obtain an impression as to the effort going into Soviet science and engineering and then hazard a guess as to Soviet success by a few concrete peg points which appear. As this article is being written, the U.S.S.R. has announced the launching of the first satellite. From our observations of Russian electronics, we could certainly state that the Soviet engineers seem thoroughly capable of handling the many difficult electronic problems that must have plagued the designers of the satellite.

We were invited to the U.S.S.R. by the Soviet Ministry of the Radio Industry and by the Popov Society, the Russian equivalent of our Institute of Radio Engineers. As a group, we represented the I.R.E. and we were invited to attend the Popov Society radio convention. In addition, we visited a number of electronic plants and laboratories in Moscow and Leningrad.

The "NAUCHNO-TEKHNICHESKOYE OBSCHESTVO RADIOTEKHNIKI I ELEKTROSVIAZI IM A.S. POPOV A" is called by the Americans "The Popov Society" for obvious reasons. There are about 15,000 members (according to Professor Vladimir Siforov, the President of the Society, who was one of our hosts). Members include engineers, technicians, and students. The convention that we attended lasted all week and ended with a concert (which, incidentally, struck us as a distinct improvement over the usual American technical convention program). The convention meetings were arranged in twelve sections, with simultaneous meetings; the program for most of the sessions lasted throughout the week. There were sessions on the following subjects:

Information Theory, Antennas, Semiconductors, Television, Automatic Radio Technology, Electronics, General Radio Techniques, Receivers and Transmitters, Telephone and Telegraph Wire Communications, Measurements, Broadcast, Sound and Electroacoustics, and Propagation.

Because of the language barrier, it was difficult for our group, in spite of the liberal use of interpreters, to follow the Russian technical papers in detail. However, there seemed to be heavy emphasis on review papers that would be helpful to students and inexperienced engineers. After each paper, the chairman called for a volunteer to present a critical discussion of the paper. Sometimes the papers would undergo a spirited attack when there was disagreement on certain of the author's theses. There was no radio engineering show included in the convention, but a few new components were shown by speakers during their papers.

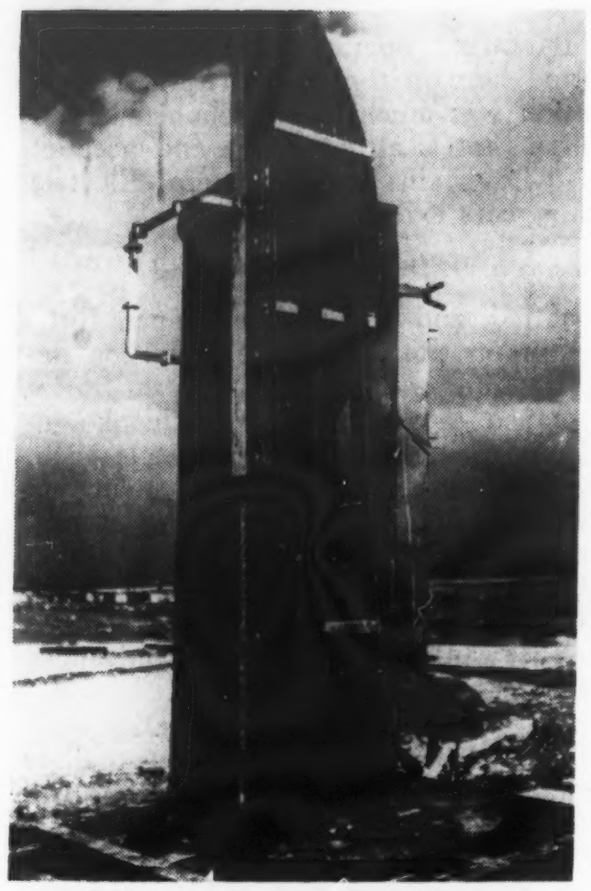
Since we found that the language barrier made it difficult for us to listen to technical papers, we asked our hosts to shift plans over to a program of visits to plants and laboratories. This was willingly done and we spent most of the remainder of our stay (except for attending the final closing session of the convention) in such visits.

We visited the following places:

A resistor plant in Moscow making deposited-carbon resistors,

A selenium rectifier plant in Moscow making rectifiers in the range of 50 milliamperes to 80 amperes,

The U. S. Delegation is photographed with their Russian hosts at the Radio Moscow Transmitting Station called Radio Town. Lower front row, left to right, are: Mr. Koreef, Deputy, Radio Town; Mr. Yerigin, Chief Engineer, Department of Internal Communications, Ministy of Radio Communications; Mr. Charles Rouault; Mr. Robert Schulz. Second row: Mr. John Dyer; Unidentified; Professor Siforov, President, Popov Society; Mr. Axel Jensen; Mr. Dosytcheff, Director, Radio Town; Unidentified; Unidentified; Mr. Lichuchin, Chief Engineer, Ministry of Radio Industry.



The X-band pill box feed for the Radio Telescope at Pulkovo, about 10 miles south of Leningrad.

excellent and there was no doubt in our minds that within a relatively short time they would be able to produce very good color televison. We were told that they were presently engaged in building color television receiver tubes of the shadow-mask type but that they did not yet have any ready to show us. However, judging from the workmanship apparent in their camera tubes and, in particular, in their image orthicon, it would seem reasonable to expect that they will satisfactorily produce a shadow-mask tube. They were very anxious to know whether any new developments over here had resulted in cheaper color television receiver tubes, and we admitted that up to now we had not made any startling developments.

Radio Astronomy Station at Pulkovo

At Pulkovo, about 10 miles south of Leningrad, there is in existence a radio telescope whose construction is certainly the most unique seen by Mr. Rouault, who has seen all of the radio telescopes now in the world. The designer of this, Professor Khaiken, pointed out that the funds available to him would not permit him to build telescopes à la Jodrell Bank or Munster-Eiffel in Germany, etc. He has, therefore, made use of a subterfuge to construct a telescope having a focal length of 50 meters and physical aperture of 75 meters, utilizing a section of a paraboloid. The paraboloid section is a horizontal slice that is formed by a row of flat mirrors, each mirror being adjusted in angle of tilt to correspond accurately to the theoretical paraboloid contour. The construction of the mirror is shown in the picture, where not all of the mirrors have been adjusted to the correct position (page 15).

Professor Khaiken plans to conduct investigations at 3, 9, and 10 centimeters. For this purpose, he was able to show by actual measurements that he has a resolution of the order of 1½ minutes of arc, one particular recording showing a track of a sunspot moving across the sun over a period of several days with only a portion of the mirrors being used. The feed of this particular parabolic section consisted of a pillbox having an aperture of about 4 feet and excited in the TE mode. In this particular installation, the receiver connected to the feed utilized normal tubes and Soviet crystals, a bandwidth of 20 megacycles at an IF of 60 megacycles, from which a noise figure of 13 db has been obtained.

One of the most interesting topics that we discussed with many people during our trip was the decentralization plans, which have been partly put into effect. During our visits to the factories, we were surprised to find that the Russian managers were extremely eager to talk about the methods used in the U.S.A. to manage sales, market analysis, procurement, production control, and so forth. We soon found that the reason for these questions was that the decentralization of portions of the electronic industry was expected to occur very soon. Under the decentralization plan, the management of a Soviet electronic plant would be responsible for almost the same functions as are common in U. S. industry. The central ministry in Moscow retains control of capital for new-plant construction and also of all research. Otherwise, the Soviet electronic plant will be quite free to operate within the economic area in which it is located. When we heard our hosts discussing these matters and talking about making a profit as well (profit is used for management and worker bonuses and for fringe benefit type facilities), we almost concluded that we were back in the U.S.A.

It will be remarkable if the U.S.S.R. can accomplish a transition to a decentralized industry without serious difficulties. However, most Americans would agree that in the long run, the decentralization program will greatly benefit Russian industry through the lifting of tight controls and the consequent emergence of capable local management.

Add Russian Electronics Story . . .

Supplementing this article on Russian Electronics is "Automation in the USSR" which appeared in the August SIGNAL . . . stockpiling information for SIGNAL readers.

SIGNAL, AUGUST — MOSCOW BALL BEARING PLANT

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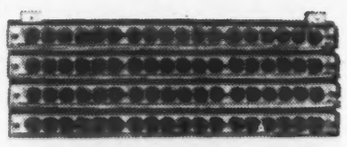

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Stockpiling and Readiness

Maj. Gen. Alvin L. Pachynski, USAF
Director, Communications-Electronics, USAF

STOCKPILING IS AN INTEGRAL PART of readiness. The Air Force's primary mission, the defense of the United States, depends on its being constantly ready, always on the alert to ward off any aggressor.

Manpower and equipment, and a high degree of training are necessary to maintain that readiness. Strategic Air Command has fully trained combat bomb crews ready to go with 15 minutes notice, its aircraft loaded with thermonuclear weapons. Air Defense Command, flying the very latest supersonic interceptors, continually patrols the defense perimeters of the North American continent. Tactical Air Command, ready to provide close air support for any kind of war situation, maintains its mobile composite strike force for the task. The overseas commands are equally ready to complement the missions of these combat commands at almost any point on the globe. Backing up the capability of our combat commands are the support commands, planning and developing new techniques, testing and proving equipment which our pilots and crewmen will use, producing and stockpiling the materiel which make our Air Force the best equipped fighting force in the world.

The development and stockpiling of communications-electronics equipment plays an important part of keeping up the quality and effectiveness of our Air Force, but stockpiling cannot be considered as an end in itself. It must be considered as a significant part of readiness. With a short-war concept, stockpiling of C-E resources in some categories cannot be carried on as a separate action because the peace and war requirements are the same. This is demonstrated in the long-haul circuitry of the military services in supporting global deployment. STRATCOM, ACAN and NTX exist to support a force-in-being, ready for any emergency. Long-haul circuits pose problems which dictate that the capability for long distance communications, to a large extent, be in existence since reliance on their post-D-Day establishment would not insure timely availability. By contrast, tactical requirements are met with mobile facilities earmarked and strategically placed for rapid deployment and activation. In the latter instance, timely availability is also essential but the problems involved are different.

In the Air Force the approved C-E materiel stockpiling program in support of readiness plans is consolidated into a document known as the Communications-Electronics Consolidated Mobilization Reserve List (CECMRL). The CECMRL contains approved requirements for fixed and mobile C-E equipment necessary to support mission assignments of Major Commands on D-Day.

In the CECMRL materiel area numerous factors are considered. Some of these factors concern stockpiling of C-E facilities in centralized locations, pre-positioning (as opposed to stockpiling) of C-E facilities at or near the base of intended utilization and maximum employment of mobile equipment rather than fixed type equipment whenever feasible and practical. Fixed type C-E equipment is normally stockpiled in a centralized location for the D-Day mission. However, under some readiness plans it is essential that this equipment be pre-positioned at or near its ultimate location. Further, in many instances pre-positioning circumstances dictate that mobile or tactical type equipment be used rather than fixed type facilities. The use of mobile or tactical type equipment in pre-positioning situations is preferred because it avoids the need for construction and installation. In addition, since mobile equipment lends itself readily to dispersal, vulnerability to enemy action is effectively reduced.

The C-E materiel program of the USAF is sufficiently flexible to provide the type of equipment best suited to the situation—keeping in mind the greatest degree of readiness. Further, although the equipment may be stockpiled or pre-positioned for D-Day, changing plans may necessitate that installation of the equipment be made pre-D-Day. Under this peacetime condition, stockpiled equipment is authorized and released for installation.

Manpower to complement the materiel facilities cannot be stockpiled but it can be held in reserve by such organizations as the Air National Guard and the Air Reserve. These organizations are a vital national defense resource and help to temper the cost of defense. Readiness of these units gives us a pool of man power which is a fundamental part of the stockpile triangle: facilities, man power, funds.

Funds for stockpiling are budgeted and spent with the monies used in support of the peacetime force structure. Programing and procurement of mobilization reserve materiel are part of the peacetime materiel program. Time-phased readiness plans are supported with funds to achieve the most effective forces-in-being. Training for readiness is also supported accordingly.

An additional area of particular significance in C-E which must receive recognition is radio frequency resource limitations. Global use of the electromagnetic spectrum dictates that communicators consider the feasibility of readiness plans, regardless of the availability of facilities, man power and funds in the light of limited radio frequency allocations. It would indeed simplify life considerably if radio frequencies could be stocked for future use. Realism directs that prudent planning provide for the exigency, and that frequency plans be in readiness.

Stockpiling and readiness in the communications-electronics field have much in common, and it is essential that C-E resources be kept ready to support the over-all role of the USAF—the defense of our country.

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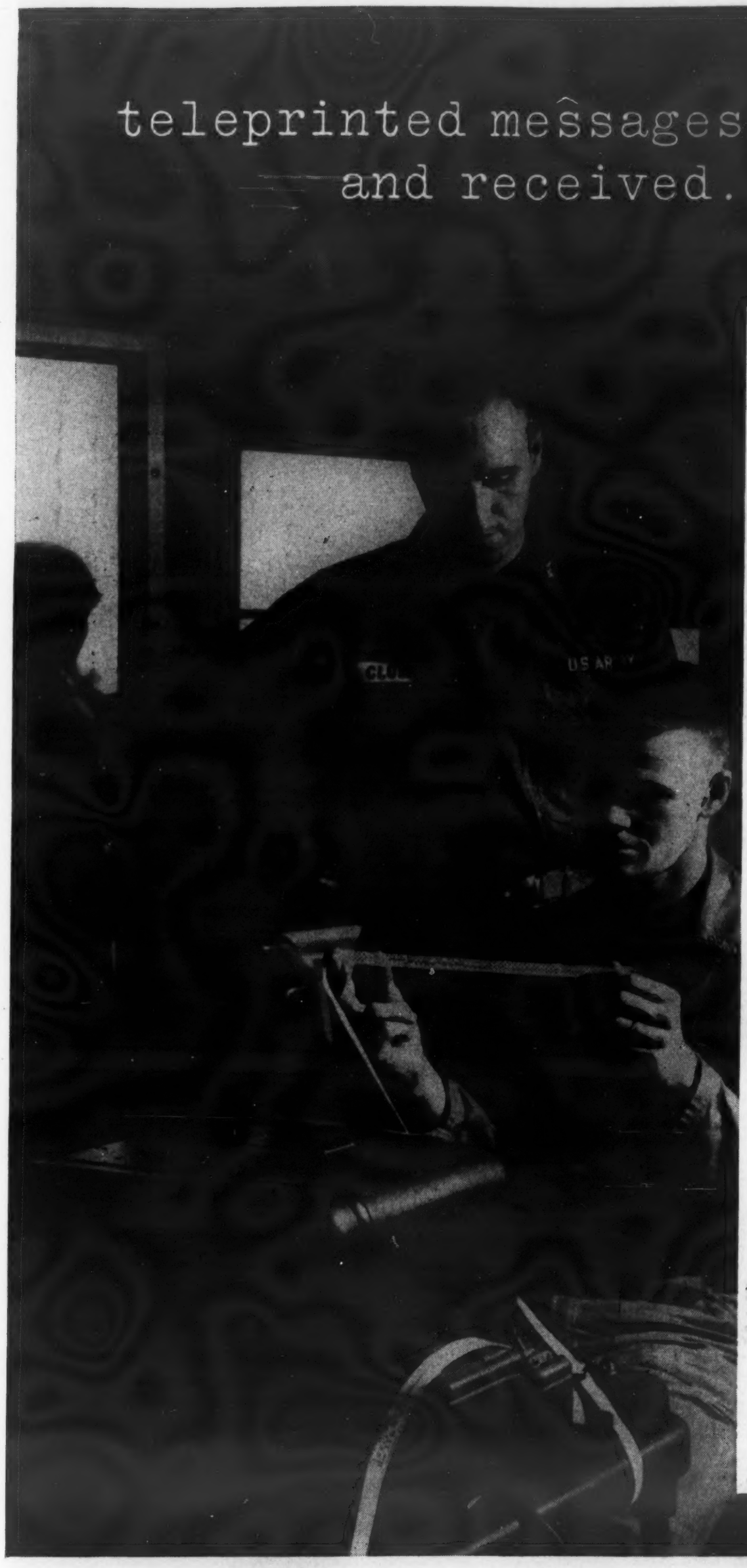

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Senator Saltonstall Talks About

Small Business And National Security

THROUGHOUT OUR NATION'S HISTORY, SMALL independent business units have been recognized as a basic and indispensable element of our free enterprise system. The inherent strength of our industrial life is a direct result of the freedom of opportunity for every citizen, possessed of the necessary energy and talent, to strike out for himself, to start his own business. While more attention is given this subject now, we can go back to 1890 to find in the passage of the Sherman Antitrust Act legislation designed to preserve the competitive structure of our economy. The question of the position of small business in our economy is neither new, nor is it partisan. It is, however, vital.

The interest in small business which has been generated during the past decade has been based on a very real concern that our competitive system is weakening. I would like to point out where these weaknesses have occurred, to examine some of the attempts which have been made to help small business, and finally, to suggest to you further steps which may be taken.

Let us first deliniate the area for discussion. There have been many definitions of small business. The Defense Department has one, the Bureau of Internal Revenue has another for its purposes and the Small Business Administration has still another.

The Department of Defense considers for procurement purposes that all firms with less than 500 employ-

ees, including affiliated, are small. This particular definition originated in the Selective Service Act of 1940. The Bureau of Census considers all manufacturing establishments with less than 100 employees as small, while the size of the distributing firms is determined by the volume of sales. The Bureau of Internal Revenue in its statistics on income separates the small from the large at the figure of $250,000 of total assets. Last January, the Small Business Administration, in cooperation with military and civilian procurement agencies, promulgated a new definition for procurement purposes. This definition provides that all concerns with under 500 employees can certify that they are small. Firms with more than 500 employees may apply for a certificate to the effect that they are small, and, on protest, a firm with less than 500 employees may even be declared not to be small business.

An examination of congressional and administrative definitions of small business reveals two important things: First, Congress cannot and should not attempt to legislate a specific detailed definition. Legislation can only establish the broad criteria upon which a definition can be made. Secondly, any definition of small business must be flexible, with particular consideration given to nondominance within a particular industry and to independence of ownership and operation.

The most important thing is to understand the problem of small business. Our aim is to maintain a vigorous competitive system, with unlimited opportunity to establish new enterprises, and, through the prevention of unfair competitive practices, the opportunity to compete in every market and to grow. More than ever before, we must bulwark our competitive system by guaranteeing small business an equal opportunity to compete.

Scope of Small Business

It is only when we consider small business in terms of total numbers that we can make a start toward understanding the essential significance of the community of independent enterprises and their vital contribution to our Nation's welfare.

Since 1939, our business population has increased in step with our population, the increase being respectively 28 percent for the business and 27 percent for the population. At the start of 1956, our vast industrial and commercial complex was made up of about 4,250,000 firms. Of these, more than 95 percent are classified by definition as small business. For the purpose of discussion about small business and national security, I shall dwell only upon the manufacturing segment of our economy in any defense mobilization program.

In the aggregate, these small companies account for a staggering 98 percent of all plants. They provide the payrolls of more than half of all workers employed in manufacturing. I think of that figure when I think of General Motors, General Electric, IBM, and some of those concerns. I remember that small business still provides over 50 percent of the employment of the millions of people who are in industry today.

Causes of Small Business Problems

Why is it that the competitive status of small firms has become such a serious problem in the past decade? Two wars, partial mobilization for defense, and unprecedented demand for civilian goods have all combined to increase our productive capacity as a Nation and to unleash new and intensify old competitive difficulties. During the world wars and the Korean War, small business had particular difficulties. In each instance the full mobilization of productive facilities, with emphasis only on implements of war as the end product, meant hardships for small business. Specifically, this mobilization for defense meant curtailment of civilian production and the imposition of controls on man power, strategic materials, prices and wages.

Larger firms are better able to convert quickly from civilian to military production. Small business is less able to compete for scarce materials and for skilled labor or to expand plant facilities.

Larger business, with greater physical resources and abundance of engineering skills and financial resources. caused procurement officers to award the vast majority of prime contracts to larger firms.

The construction of productive facilities with Federal funds and the abandonment of competitive bidding in the awarding of contracts are procedures which certainly violate our concepts of free enterprise. Even though they may well have been necessary in time of war, these procedures acted against the interests of small business.

The Characteristics of Small Business

I should like to discuss some of the characteristics of the small business concern and some of the problems confronting this type of company. These characteristics are in part the basis for many of the difficulties encountered by small business concerns.

Small business is subject to greater fluctuation in its profit rates. This characteristic also makes it difficult for a small business to accumulate long-term investment to put back into the firm, thus making frequent borrowing necessary. Outside investment is discouraged.

The tax problem is a very important one because it takes so much in taxes, if they make money, that they haven't enough money to put back into the industry with what depreciation they may have been allowed to build up. That is one of the great problems today, because banks cannot make long-term loans.

Perhaps the greatest problem of small firms today lies in long-term financing. This difficulty results from both the impact of taxes, as I have said, and the difficulties in obtaining credit. Local banks are often not in a position to advance long-term credit, both through legal limitations and their own requirements to remain liquid. These obstacles have acted as a hindrance to greater participation by small business in Government procurement.

I also doubt if small business has participated fully in the use of progress and advance payments supplied by procurement agencies. Many small businesses producing for the Government cannot meet the criteria governing the issuance of such payments.

The Senate Small Business Committee

During the period 1940-1950, temporary small business committees had been established in each Congress. In 1950, during the 81st Congress, the late Senator Kenneth Wherry sparked a successful effort to make the Senate Small Business Committee permanent. As a member of the committee since its beginning, I am convinced of the wisdom of establishing it. It has operated in a nonpartisan fashion and has worked in cooperation with other permanent committees where interests overlapped.

For many years now the Senate Small Business Committee has carefully reviewed military procurement policy and procedures. Its studies and recommendations have been conducted in a nonpartisan fashion and have been made to not only insure more efficient procurement, but to insure a better opportunity for small firms. It has

been our philosophy that, given an opportunity to participate, small businesses may in many instances compete with larger firms on a price basis.

We have found, however, that small firms have difficulty in securing adequate information on proposed procurements or in securing specifications and bid sets. It is certainly to the advantage of the Government to insure the widest possible dissemination of information. Procurement agencies must provide small firms with every opportunity to be placed on bidders' lists or to have their products placed on qualified products lists. While military departments insist that negotiated procurement procedures do permit competition, I doubt that they permit full competition. I have constantly worked to try to get procurement agencies to seek additional sources of supply among small business concerns, and that applies, as I have said, to us in New England very specifically.

Our committee has continually recommended that negotiation be reduced in as many instances as possible and that advertised procurement become the rule rather than the exception. Admittedly, there are billions of dollars worth of procurement which may not be susceptible to performance by small business concerns acting as prime contractors. It is obvious on an airplane carrier or, for instance, a B-52. This is perhaps particularly true today in the age of electronics and guided missiles. In such instances the role that small business must perform is that of a first- or second-tier subcontractor.

It is necessary with a weapons system concept of procurement that everything possible be done to encourage subcontracting to small business concerns. There has been a tendency, however, for many prime manufacturers with Government-furnished equipment to retract work which had formerly been performed by independent small business concerns. As a matter of fact, current renegotiation procedures do not encourage subcontracting. If renegotiation brings the price down and the profit down, the contractor, particularly when time is not so important, will do everything he can to get as much profit as he can rather than to subcontract.

I believe the entire subcontracting program within particular industries would bear intensive study. For instance, we should determine what duplicate facilities have been established by prime contractors, what relative costs are between use of Government-furnished equipment and independent subcontractors, and if sufficient inspection of administration of prime contracts has been exercised by procurement agencies.

Another problem which confronts small firms bidding on Government contracts is the size of various procurements. While the bid as let can be performed only with facilities of a large concern, multiple awards would permit small firms to enter the picture. I realize that this is sometimes a difficult accomplishment.

Similarly, unrealistic delivery schedules preclude small firms from participating. During the national emergency, such delivery requirements may be understandable; today many of them cannot be justified. Too frequently an invitation to bid is placed on an emergency basis, with delivery required in thirty to sixty days. For one reason or another, the bid has been cancelled, readvertised and delivery actually has run into six months or more.

One of the greatest hurdles any small businessman or association of small businessmen has to surmount is the reluctance of contracting officers to go along with an untried company. This antipathy may be a basic element of human nature and not, as some small businessmen believe, an acquired administrative attitude. As a case in point, the Secretary of the Navy on one particular occasion did decide on an award in favor of a small business firm which the officer in charge had recommended that he should not do. As a result of that, this untried small business firm developed some new method which, for the time being at least, put the Navy way ahead of the Army and the Air Force on that particular item.

Research and Development Procurement

Much has been said recently with regard to the participation of small firms in research and development work. I believe that an intensive study should be made with a view to increasing the share of small business in this field. Here again, proprietary interests developed in wartime are carried over into the peacetime economy, altering the competitive structure of many industries. Small firms must, to remain strong, share in these benefits.

By the nature of things, a research and development contract for a new product is important for any company to acquire. Should the product developed be one that the military eventually will use in large quantities, the developing company will often find that it has a long head start over its potential competitors for a profitable production contract for the new item.

I know that on a big scale—in fact, this is not a proper example—on the Aircraft Carrier *Forrestal*, which was built in Norfolk, we tried to get a contract for the Fore River Shipyards in Quincy. The Norfolk people could underbid us on the next carrier because they had had experience on the first carrier. Consequently, our bids were way above the Norfolk bid. That is perhaps not a strict example of what I mean, but it does show the advantage that a company has when they do pioneer in an effort.

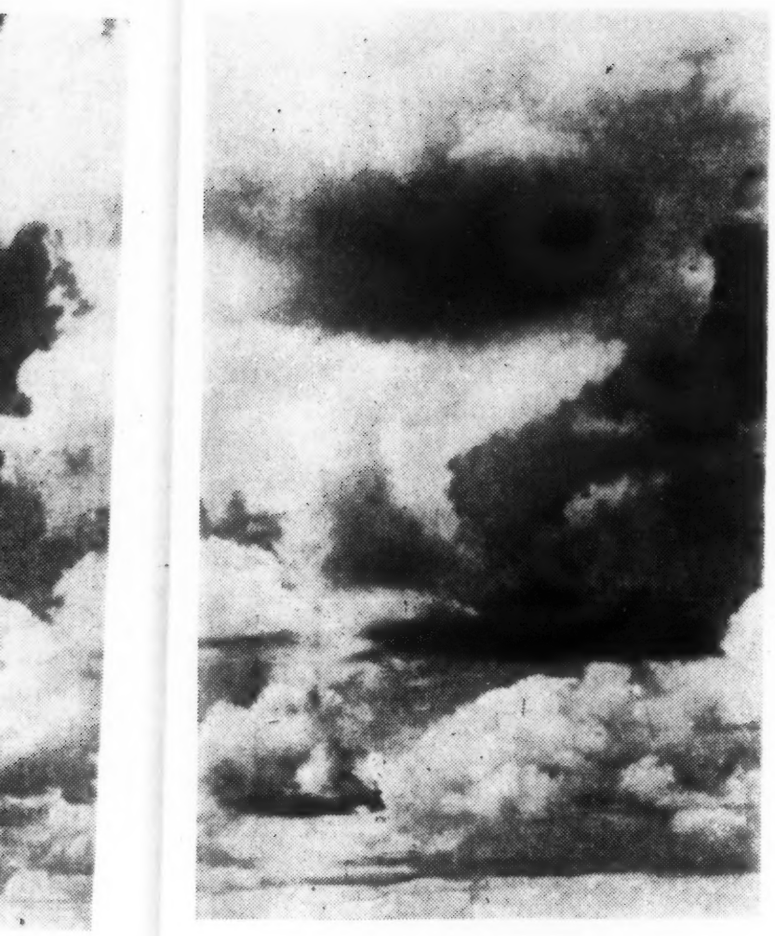
For the period 1 July 1955, through 30 June 1956, small firms obtained less than six percent of the more than $2,341,000,000 which was spent by the Department of Defense in research and development work. Here, then, is a specific area of procurement which presents a challenge to Government procurement officers. It should not take much effort to expand the small business share of research and development contracts—an objective, I feel certain, which is both desirable and obtainable.

The military agencies and other agencies of the Executive are constantly making plans for the mobilization of the Nation's productive resources. It is most important that such plans provide for the greatest use of the small business potential. They must provide for equitable allocation of scarce materials, machine tools and manpower, with serious consideration being given to the impact of any controls which will be considered necessary. Consideration must also be given to the need for financial assistance and tax benefits. Above all, these plans must be formulated well in advance. In both World War II and the Korean conflict, consideration for the particular needs of small business came too late to prevent damage to their competitive position in the economy.

Finally, in regard to procurement, I wish to state most emphatically that the consideration which will be given to small business depends not just on the laws enacted by Congress, but primarily on the attitudes of the men who administer these laws. A constructive attitude must prevail from the highest echelon down through the contracting officer and the plant inspector. It is most important that all in authority understand the vital and essential role of small business in our economy. They must understand that small firms require at least equal opportunity, free of man-made impediments. In such a

(*Continued on page* 58)

ELECTRONICS AND THE STRATE
SAC
MAND



SAC is considered the Free World's primary hope for continued world peace through the maintenance of its deterrent striking air power in a combat-ready status. Its bombers and crews are in a continual state of training, honing to razor-sharpness the ability to carry out the combat mission if the occasion should ever arise.

by Gen. Thomas S. Power, USAF, Commander in Chief, Strategic Air Command

It is generally known that the Strategic Air Command is the Nation's long-range nuclear air arm. But few people realize the scope of the effort involved in creating and maintaining a combat-ready, global striking force.

When SAC was activated in 1946, it had 600 airplanes, 250 of which were bombers, and only three jet aircraft. Total man power was about 37,000; there were 18 active bases.

Today, barely 12 years later, SAC represents an investment of some 17 billion dollars — more than three times the assets of the largest U. S. industrial concern. This figure includes a 10.8 billion dollar capital investment in materiel, in real estate and in over 2700 bombers and tankers with a high percentage of jets in addition to hundreds of support aircraft. 6.2 billion dollars represents the training cost of SAC's personnel whose number has risen to over 200,000, stationed at more than 30 bases in this country and over a dozen bases overseas.

I have cited these figures, not merely to emphasize the vastly expanded demands of strategic air warfare, but also to give you a feel for the magnitude of an endeavor in which electronics plays such an exceedingly prominent role. To fully appreciate this role, it is necessary to understand the purpose and scope of SAC's mission. Briefly stated, that mission is ". . . to be prepared to conduct strategic air operations on a global basis so that, in the event of sudden aggression, SAC could immediately mount simultaneous attacks designed to destroy the vital elements of the aggressor's war-making capacity to the extent that he would no longer have the ability or will to wage war."

SAC's Mission

SAC's capability to accomplish its mission and the fact that this capability is well known to the Soviets act as a potent deterrent to aggression which, in effect, is an added objective of SAC's mission and its primary purpose in the cold war.

I want to direct your attention to three words I used in stating SAC's mission, namely "global," "immediately" and "simultaneous," because the fundamental qualifications denoted by these three words would not be possible without electronics—especially in the field of communications.

The requirement that our operations be of global character entails not only that our bases are scattered all over the world but also that, at any one time, SAC aircraft can be found flying anywhere in the skies. In order to permit the immediate and simultaneous employment of this far-flung system of bases and aircraft whenever necessary, we must be able to make rapid and positive contact with every one of SAC's multitudinous elements, whether on the ground or in the air. This requires what is undoubtedly the most extensive and complex communications network in existence. The focal point of this network is the subterranean control center, a marvel of advanced electronics, which is located in SAC headquarters at Offutt Air Force Base near Omaha, Nebraska.

The Crucial Test

The crucial test of the effectiveness and adequacy of SAC's communications network would, actually, last only a few minutes—the fateful minutes following notification that aggressive action has been initiated against this country. As enemy bombers or missiles streak toward our shores at near-sonic to supersonic speeds, the SAC control center goes into immediate action in implementing SAC's well-rehearsed emergency war plan and in launching its alert forces throughout the world for the all-important counter-strike, with every crew member thoroughly familiar with the target assigned to his airplane.

Much of SAC's planning, training and preparations serves to insure that nothing will go wrong in these few minutes. There must be no breakdown in our communications anywhere along the line, either through equipment failure or enemy action. And, no matter how unexpected and devastating the enemy's attack, we must be able to preserve enough strike capability to inflict more potential damage upon the aggressor than he is willing to accept. Here again, we need foolproof communications and a host of other electronic devices.

Preservation of at least some degree of strike capability, even under the most adverse conditions, involves a number of measures which, generally, fall into four areas. The first is the detection and prevention of concerted acts of sabotage which would be designed to keep SAC's forces pinned down while the enemy's attack is in progress. Next, we must "harden" our bases and launching sites in order to lessen the crippling effects of battle damage, although we can do so only to a limited degree lest we affect our quick reaction capability. The third area of protective measures entails the dispersal of our aircraft over a larger number of bases which has the added advantage of permitting more expeditious launching of our counter-strike force.

But all of these measures are of a purely defensive nature and cannot, by themselves, guarantee the preservation of any predictable degree of our strike capability, especially since it can be expected that the initial objective of a surprise attack would be an all-out effort to destroy SAC's forces while they are still on the ground.

Therefore, our principal insurance of preserving a specified percentage of our strike forces for the counter attack, against all odds, is to get a commensurate number of our planes in the air before they can be hit by the enemy. This means that we must maintain that percentage of SAC's aircraft, fully fueled and armed, plus their crews and support systems on continuous alert, ready for launching at a moment's notice. It is my considered opinion that SAC's alert system is the very backbone of our deterrent strength. For, as long as a potential aggressor knows that even the best prepared surprise attack with bombers, missiles, or both, cannot prevent a sizeable alert force from counter-attacking him, he will be strongly deterred from undertaking aggressive action.

The value of the alert principle hinges largely on the effectiveness and reliability of the communications system. The slightest delay or failure could have grave consequences because the time from detection of hostile action to the arrival of enemy bombers over this country has shrunk to a few hours and to even less for our overseas installations. When long-range missiles become operational, the warning time will further decrease to a mere fraction of an hour. Every second which improvements in comunications and electronics can gain for us will mean additional SAC planes and later, missiles in the air for the counterattack.

In addition to communications, electronics serves SAC in many other important applications, such as the ingenious navigation systems which permit accurate navigation to targets thousands of miles away, in any type of weather and over the circuitous routes dictated by operational re-

quirements. Precise navigation is also mandatory for rendezvous with aerial tankers, as any errors delaying or preventing such rendezvous can result in the failure of the entire mission, if not in the loss of an airplane and its crew.

Normally tied in with the navigational equipment are the electronic bombing systems which assure pinpoint accuracy in hitting targets from very high altitudes, at near-sonic speeds and in any type of weather. The complexity of this equipment is illustrated by the fact that an advanced bombing and navigation system may weigh as much as a ton—40 times as much as World War II's Norden Bomb Sight! It takes an aggregate 1500 electronic tubes to operate this equipment, the intricate fire control system, the communications gear, certain types of instruments and all the other electronic devices needed on a modern jet bomber such as the B-52.

Among the untold applications on the ground, electronics finds increasing use in improving techniques of weather forecasting and of transmitting world-wide weather data to our operating elements. Electronics also helps us to conduct our war games on which much of our future planning is based. Expressing such variables as type and size of attack, timing, rate of recovery and similar factors in mathematical terms, we use electronic computers to determine the planning necessary for innumerable sets of conditions that might result from any type of aggressive action against this country. Closed-circuit color television now makes it possible for the key personnel at our headquarters to perform their normal duties and, without leaving their desks, observe the huge plotting board in SAC's subterranean control center which presents a detailed and up-to-date picture of the deployment of SAC's entire force.

Time does not permit me to enumerate all of the manifold electronic applications which contribute to SAC's mission nor to discuss any of these applications in more detail. I am sure that what I have said so far leaves little doubt as to the vital part electronics plays in SAC's operations. But this very dependence on electronics has created some grave problems, especially with respect to reliability. There is no need for me to dwell on this subject because I know that you are fully aware of its urgency and that much is being done toward continuous improvement. But I hope that my observations have served to re-emphasize the urgent need for attaining the utmost reliability of equipment whose performance may well spell the difference between success and failure of SAC's mission.

There has also been some improvement in maintainability, another problem area. However, far more improvement is needed to help us cope with our shortage and costly turnover of skilled personnel. In many instances, reliability and maintainability go hand in hand. In addition, better maintainability means a higher percentage of airplanes available for the alert system, less stand-down time for maintenance, more rapid training of replacements for the many experienced maintenance personnel who fail to re-enlist, and an over-all reduction in the cost, scope and complexity of our extensive support activities.

Consolidating Our Gains

Generally speaking, I believe that we have reached the point in the advancement of the electronic art where we should heed the age-old military theorem of consolidating our gains. This does not mean that we should slacken our efforts in advancing the state-of-the-art and in finding solutions to new problems as they arise. But I think there is a great need for better exploitation of the technological gains we have made in recent years.

This applies not only to reliability and maintainability. We also need greater self-sufficiency of our maintenance facilities and far less dependence on extraneous support equipment, especially in view of the growing dispersal of our strike forces and the remote location of many of our bases. Warm-up and check-out requirements for electronic equipment must be reduced and, preferably, eliminated altogether, because we can no longer afford to lose precious minutes as warning periods for the launching of SAC's alert aircraft and future missiles keep dwindling.

While there has been gratifying progress in the utilization of the "electronic support systems" approach, the products of many electronics manufacturers are still frequently incompatible with the components supplied by other manufacturers or with the aircraft itself. Closer cooperation among the various suppliers of electronic equipment and with the aircraft designer would help immeasurably in producing a true weapon system instead of an airplane packed with a conglomeration of diverse electronic gear.

A more thorough systems approach would also enhance consideration of maintainability and optimum producibility in the initial stages of development and design. Added advantages would be savings in weight and cost. The importance of saving weight is strikingly illustrated by the fact that each pound of electronic equipment requires about ten pounds of additional weight in order to maintain the airplane's specified performance.

There are also many challenges in the technical field. Electronic equipment will have to withstand increasingly severe environmental and operating conditions, such as: it must become less susceptible to atmospheric disturbances and jamming; means must be found to cope with the ever worsening crowding of the radio frequency spectrum; new techniques, such as scatter communications, should be exploited to the fullest extent; there is an urgent requirement for more and better test equipment and training aids.

Most of these problem areas apply to SAC's manned bombers as well as to the long-range missiles which will be added to SAC's inventory of weapons systems as rapidly as they become operational. While the potential employment of missiles by either side will not change SAC's basic mission, such factors as the great decrease in warning time will affect the manner of accomplishing that mission. SAC's organization of highly experienced professionals, its principal asset, is flexible enough to adapt itself readily to any new tools or techniques of warfare, no matter how revolutionary. But this, in turn, requires continued improvements in existing support equipment, such as communications which permit us to keep pace with the increased technological demands posed by the new weapons.

These challenges dramatize the need for devoting more effort to the consolidation of our gains so as to establish a solid foundation for future progress. This will become more important as I am convinced that we have barely scratched the surface in tapping the potentialities of electronics and that the future will bring advances and discoveries far beyond our imagination and dreams today.

As the science of electronics grows, so will its contribution to the accomplishment of SAC's global mission. Thus, electronics is destined to serve not only the enrichment of our civilization but also its preservation.

western union looks ahead

by Walter P. Marshall—President—Western Union Telegraph Co.

WITH EVERY CONFIDENCE IN THE LONG-TERM outlook for the continued growth and expansion of record communications, Western Union is moving ahead with plans to provide further improvements and expansion in the range of its services.

Notable among present and future developments are the following:

1. *Microwave Radio Beam Expansion*

Western Union's microwave beam system, extended westward from Pittsburgh to Cincinnati and Chicago in the latter part of 1957, is scheduled for operation early this year. It will furnish immediately about 1,000 additional telegraph channels in the heavily industrialized midwest area for use in general telegraph service and for leasing to industry and Government. Further development work, now in progress, promises an eventual capacity up to 5,000 channels over the extended system.

Western Union's microwave radio system has demonstrated its ability to carry telegraph, facsimile and other signals fast and efficiently. Beam facilities are particularly suited for broadband transmission systems where many channels are required. They have additional advantages over wire circuits since they are not subject to interruptions from storm damage and electrical interference.

Tower sites are being acquired for additional westward routes reaching from Indianapolis to Kansas City via St. Louis, and from Cleveland to Chicago via Toledo and Detroit. Western Union's ultimate planning is for a nationwide network of microwave facilities linking important cities and defense areas.

2. *Improved Service for Teleprinter Customers*

Development of special transmitting equipment for use by teleprinter customers is expected to speed and further improve telegraph service. While many customers are now linked directly with Western Union's nationwide electronic network, permitting them to flash their messages directly to destination, the number will be expanded in 1958 through the employment of new techniques.

3. *Facsimile Progress*

Installation of more Desk-Fax machines to improve service and stimulate added telegraph use is continuing. Desk-Fax machines, over which telegrams may be sent and received in facsimile form simply by pushing a button, are now in service in about 32,000 business offices. Another 22,000 firms are equipped with teleprinter machines, making a total of 54,000 telegraph customers connected directly with central telegraph offices. In addition to the benefits of more convenient and speedier service, Western Union customers receive a discount of 20 cents on each prepaid domestic telegram in excess of 50 a month sent over direct-wire connections to telegraph offices.

Leasing of Intrafax (facsimile) systems to speed intra-company communications in "picture" form is now producing revenues at an annual rate of more than $1,000,000. The service, only four years old, is growing at a steady pace and more than 1,700 Intrafax units, using nearly 10,000 miles of circuits, are now operating nationwide. Systems range in size from units linking two floors in a building to those using several hundred miles of circuits connecting widely scattered branches.

Three of the world's longest Intrafax systems are now serving the U. S. Air Force linking the Strategic Air Command base at Omaha with bases in California, Massachusetts and Louisiana. On-base Intrafax systems are in use at 21 Air Force bases in 17 states, speeding telegrams in facsimile form from communication centers to outlying areas.

In connection with further Intrafax developments, Western Union's new flat-bed facsimile transmitter, with its automatic loading feature, has several advantages over the more common type of facsimile transmitter. With the flat-page or flat-bed transmitter, messages to be sent are simply laid on the machine's table, from which they are automatically drawn through the machines by rollers. Messages may be of any length and copy from a teleprinter can be fed directly, continuously and automatically into the transmitter. An important development, still in its early stages, is long-haul facsimile operation on voice channels, employing vestigial sideband transmission, which permits double our usual speeds. Vestigial sideband transmission is the first important step toward progress in transmitting more information over a given band width.

4. *New Service to Canada*

The first customer-to-customer teleprinter exchange service between the United States and Canada, called Telex, is being placed in experimental operation early in 1958. It will be operated jointly by Western Union and the Canadian telegraph companies and will link a number of customers in New York with Telex subscribers in all Canadian cities. Telex enables any subscriber in the network to reach any other subscriber immediately and automatically without the necessity of relaying the call through a manually operated switchboard. The results will aid us in determining the desirability of extending the service to other cities in this country.

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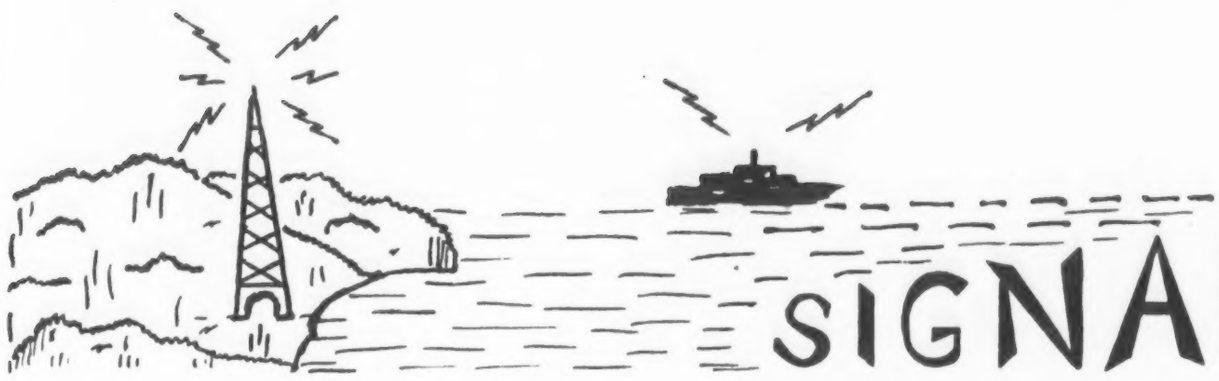


SIGNAL·GRAM

— GOVERNMENT —

ELECTRONIC WEATHERMAN DEVELOPED AT FT. MONMOUTH, N. J. This new system is designed to predict high altitude indications of oncoming storms, hurricanes, tornadoes and other bad weather faster and more accurately than any previous device. It is the first system capable of charting high velocity winds such as the jet stream on a routine basis. A three-pound weather station, called a radiosonde, is transported aloft by a balloon and coded radio signals are dispatched to specially designed computers for processing into usable humidity, temperature and wind readings. A balloon can be automatically tracked by the system to an altitude of 24 miles at a distance of 200 miles—a range twice as effective as former equipment.

TRANSISTORIZED EQUIPMENT FOR CIVIL DEFENSE For the first time, a transistorized dosimeter charger for civil defense use has been approved and ordered into production by the Federal Civil Defense Administration, Battle Creek, Michigan. Because of its completely electronic nature, the dosimeter charger is simple to operate and should expedite civil defense training in its use. This contribution to national defense is manufactured by Universal Transistor Products Corp., Westbury, New York.

NATIONAL SCIENCE ACADEMY PROPOSED A bill to provide the establishment of an academy to be known as the "United States Science Academy" has been proposed by Congresswoman Katharine St. George of New York. This bill, H.R. 6164, provides for the training of selected men and women, between the ages of 17 and 22, as scientists and engineers for service as officers and employees of the United States. The bill, now pending in the house, provides for full tuition and a suitable allowance for selected students. Representative Victor Anfuso of New York has proposed a similar bill for patterning the school along lines of the service academies and being established under Government auspices.

CONTRACTS: ARMY: El-Tronics Inc., radiac sets, $134,985; General Electric Co., operating computer center at Ballistics Missile Agency in Huntsville, Alabama, $1,500,000 annually; Western Electric Co., Inc., communications system development, $96,354; Microwave Associates, Inc., research and development program for tubes, $62,953. NAVY: Servo Corp., dead reckoning tracer automatic navigation systems, $640,000; Raytheon Manufacturing Co., 133 small-boat radars, $548,700; New York Shipbuilding Corp., construction of the world's first atomic-powered merchant ship, $20,908,774; Norden-Ketay Corp., development of a new bomb director system for planes based on aircraft carriers, $4,000,000; Olympic Corp., ultra-high frequency radio direction finding equipment, $1,306,000. AIR FORCE: Federal Electric Corp., White Alice Communications System, $2,500,000; Barnes Engineering Co., high resolution tracking system, $87,570; AC Spark Plug Division of GMC, amplifiers and gyro assemblies, $1,477,619; International Telephone and Telegraph Corp., scatter communications system, $1,523,854; Standard Coil Products Co., Inc., aircraft camera control system, $142,094.

— INDUSTRY —

PHILCO TECHNOLOGICAL CENTER To help meet the man power shortage in technology, the Philco TechRep Division has announced that it is making the training facilities of the Philco Technological Center, located at 22nd and Lehigh Avenue, Philadelphia, Pa., available to all. Previously, these training facilities were available only to Philco personnel. The Center will offer specialized correspondence courses only; for example, their course on transistors is designed for the experienced engineer and technician now engaged in the design, manufacture and installation or maintenance of electronic devices and systems.

NEW DICTATING MACHINES have been introduced by Dictaphone Corporation and Sound-Scriber Corporation. The new dictaphone features an all-transistorized amplifier which virtually eliminates amplifier repairs, needing no warm-up period. The Sound-Scriber is a portable unit which is powered by four standard flashlight batteries; being transistorized and completely self-contained, the operating cost is 5¢ per hour.

SPLIT-SECOND CHEMISTRY Bendix Aviation Corporation is producing a new electronic instrument that can analyze an instantaneous sequence of chemical reactions, having numerous applications in the science of missilry and rocketry. The new device, called a "Time-of-Flight Mass Spectrometer," can make a complete analysis of the chemicals in a rocket fuel explosion in one ten-thousandth of a second. The instrument operates on the principle of instantly identifying vaporized gases, liquids and solids (including metals) by revealing their respective molecular masses.

ANALOG COMPUTER CENTER The first high precision analog computer center in the United States, which will help meet the Soviet Union's challenge in guided missile and space satellite development, will be opened in New York City in February, 1958, by Mid-Century Instrumatic Corp. The Manhattan Computer Center will make available 136 amplifiers and expects to operate 24 hours a day, seven days a week, with a staff of specialists to assist computer users. The company has received security clearance and is already booking time for subscribers.

STANDARDIZATION Tung-Sol and Raytheon soon will begin producing the same transistor listed as the same number. General Electric may join them. This standardization in the transistor market is a monumental step in competitive industry. Concerning the flooded market of electron tube duplications, Donald W. Gunn, general manager of Sylvania's Electronic Products Sales Department, recently stated that the lack of standardization in electron tube design could result in hampering the electronics aspect of any coordinated military defense effort.

ANOTHER USE FOR SOLAR ENERGY A water pump powered by the energy of the sun, which could eventually be applied to turn desert areas into fertile fields, is the latest application envisioned for solar energy. Developed by Hoffman Electronics Corporation, the pump operates by means of a solar energy converter constructed by silicon solar cells. These cells convert sunlight into electricity with an efficiency which makes their practical application feasible.

— GENERAL —

SELLING TO THE GOVERNMENT The Small Business Administration has announced a new publication called the "ABC of Selling to U.S. Government." The booklet describes how the Government buys, giving suggestions on selling to it, and discussing SBA services to small firms in selling to Federal purchasing agencies and their prime contractors. Copies are available from the SBA, Washington 25, D.C. and from Agency field offices.

INTENSE HEAT University of Chicago scientists have developed a water-stabilized electric arc which can produce heat twice as hot as that of the sun's surface. The resultant heat will be used to test metals for use in the future aircraft and spaceships and in nuclear reactors for electricity production.

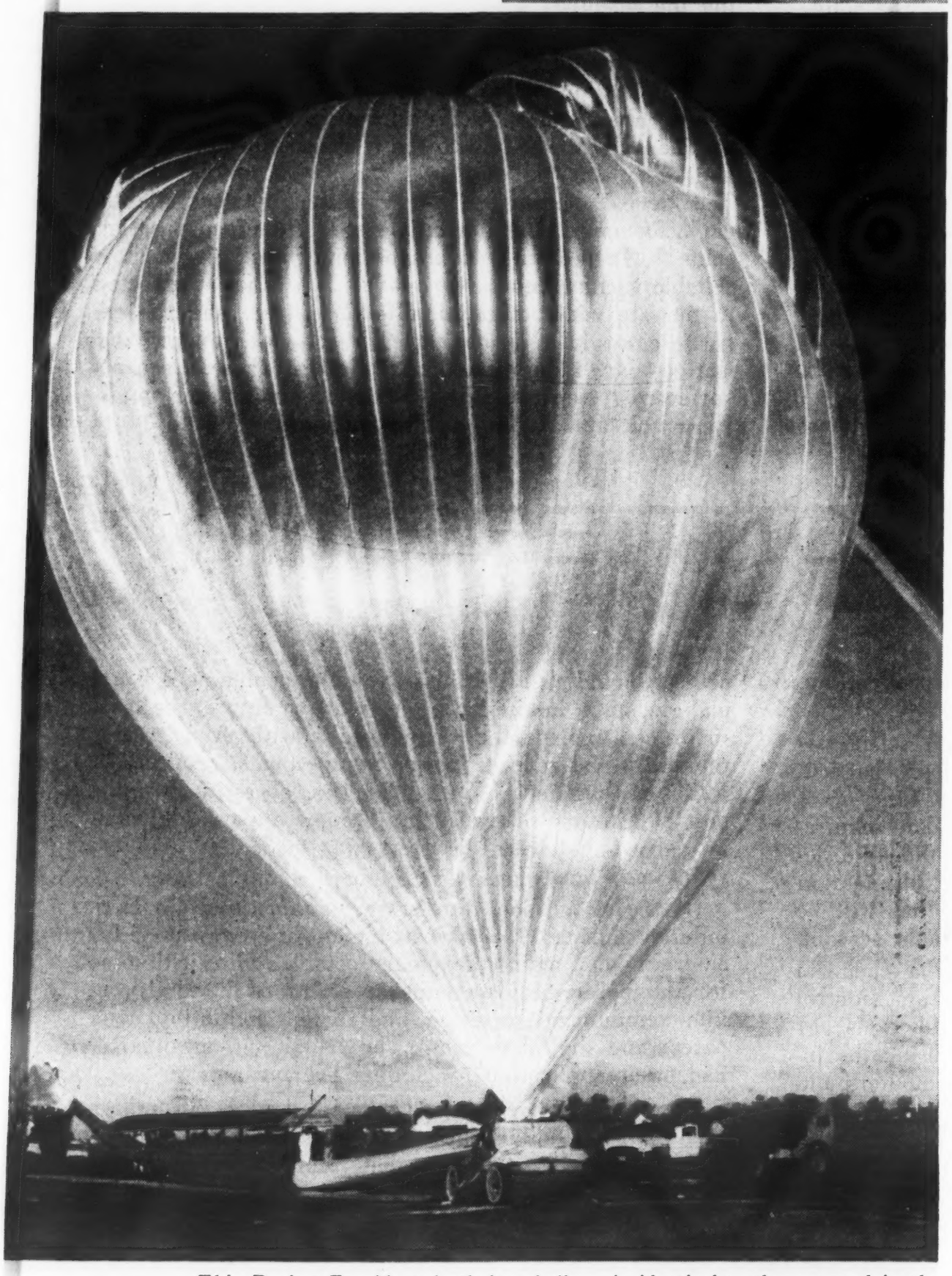
ELECTRONIC HOTEL RESERVATION SYSTEM The Sheraton Corporation of New York's Sheraton-McAlpin Hotel has unveiled the first phase of a nationwide electronic hotel reservation system to be completed by October 1958. Ultimately, the system is expected to store data on 43 hotels and handle reservations directly from 38 of them by means of a system developed at Teleregister Corporation, Stamford, Conn., a subsidiary of the Ogden Corporation. The hotel system is similar in many details to those for airline reservations use.

NEW LOOK IN E BONDS The sixteen-year-old Series E Savings Bond has gone modern. Since October 1, 1957, the E Bond has appeared in punch-card form, and is slightly smaller in size. The Treasury has modernized its record-keeping ability that makes every Savings Bond "absolutely indestructible." As a taxpayer, you share in a half-a-million-dollar-a-year saving in printing costs.

EIA SECOND NATIONAL CONFERENCE ON AUTOMATION SYSTEMS is scheduled for January 22-24, at Arizona State College, Tempe (Phoenix), Arizona. The conference offers the opportunity for evaluation of automation in all important aspects as it has developed thus far and as its potential is discernable for the immediate future.

FOURTH ANNUAL MILITARY-INDUSTRIAL CONFERENCE will be held in Chicago, February 17-19, at the Conrad Hilton Hotel. Approximately 1,200 representatives from commerce, industry, Government, scientific and professional fields, higher education, and the Armed Services will assemble to hear nationally noted speakers focusing their attention on the conference theme, "The Role of Commerce and Industry in U. S. National Strategy."

The artist's drawing shows Aeronutronic Systems' four-stage rocket leaving its launching station, a General Mills balloon. With much of the atmospheric drag behind it, the rocket can soar to far greater heights than those launched from usual earth stations.



This Project Farside polyethylene balloon is identical to the one used in the actual rocket flights. Here it is being readied for a test ascent. Its load is an exact replica (size and weight) of the platform and rockets which were carried to 100,000 feet at Eniwetok Atoll.

We build rocket stations in the sky to speed man's conquest of space

In Project Farside, General Mills' polyethylene balloons like this, the largest ever flown, lifted a series of rockets 100,000 feet above the earth. (The nearly 4,000-pound loads were the greatest ever carried to that height.) With 98.7 percent of the drag-producing atmosphere already behind them, the rockets could then be sent farther out into the unknown to gather scientific data essential to man's mastery of space.

Unusual projects of this type are a specialty of the complete balloon systems group at General Mills. The complete package includes balloon and instrument design and manufacture, launching and recovery services, weather forecasting and data reduction.

Such activity is representative of our capabilities and thoroughness in other fields: inertial guidance and control, infrared, radar, semiconductor physics, and so on. We combine creative engineering and research with fine-precision production to serve an increasing number of industrial and military customers. We'd like to serve you, too.

GET MORE FACTS about our facilities and capabilities and how they can serve you. Write Dept. SI-1, Mechanical Division, General Mills, 1620 Central Ave. N.E., Minneapolis 13, Minnesota.

MECHANICAL DIVISION

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NEW FRONTIERS IN

SOME CYNICS HAVE SUGGESTED THAT THE CAUSE OF the fantastic increase in the number of solid-state scientists is simply that the phrase "solid state" has suddenly become fashionable. The term "solid-state physics" was contrived by scientists to distinguish the physics of solids from the physics of the other two states of matter, namely gases and liquids. If the word "state" were left out, one would have "solid physics," which might mean something else again.

A friend of mine who is also a poor punster has pointed out the parallel between the solid state and the largest state of the union: solid state physics covers a tremendous amount of territory; it has great wealth both on the surface and beneath the surface; its spokesmen are inclined toward being long-winded, and it is a subject about which one must not necessarily believe everything one hears.

Why all the sudden interest—particularly on the part of industry—in solid-state research? One obvious answer is in the now widely quoted sales figures for the solid-state's most glamorous product: the transistor. This business, which was non-existent five years ago, amounted to $12 million in 1955, grossed $30 million in 1956, and should—according to the best estimates—reach $200 million by 1960.

Aside from the heartening prospects for selling solid-state devices themselves, I believe industry's growing interest in this field of science is related to what industry needs for itself, in addition to what it will sell to others. It is not appropriate here to enter a discussion of the economics of "automation." Those who have made the most careful studies of tomorrow's population trends and production requirements describe automation not as a problem of the future but rather as the only solution to a problem of the future. Suffice it to say that almost every industry will become increasingly dependent on, and interested in, automation.

Much of industry's interest in solid-state science is related to the importance of solid-state devices—particularly electronic devices—to automation. A key function of electronics in automation is control, and the key requirement for control elements is reliability. Solid-state devices give every promise of providing the ultimate in long life, low maintenance and reliability that will be required if automation is to be a dependable servant.

Included in control—whether control of a chemical process, control of a manufacturing operation, control of inventory or of distribution—are three functions: 1) sensing the actual state of affairs, 2) processing the information so obtained with such aids as computers and instructions stored in memory devices and 3) finally, the execution of the control. For all these control tasks, solid-state devices are being developed at an ever-increasing pace, and particularly for the first two. For sensing elements, there are tiny devices that see (photo detectors), hear (piezoelectric materials), feel (magnetic materials) and smell (leak detectors). I do not think of a solid that tastes, but it might be made if there were sufficient demand for it. There are many forms of solid-state substitutes for brain cells, although none thus far which could reproduce the complexity of the human brain in anything smaller than a warehouse packed with approximately ten billion transistors, ten billion transformers, ten billion solid-state memory cells and more wire than anyone—even a machine—would want to think about. Solid-state devices can talk and they can do. And best of all, by performing these functions in solids, we can foresee the day when all of these devices can be built to last a lifetime, using very little power to operate them and requiring no maintenance.

Certainly, industry is interested in solid-state science because it can *sell* the products created as a result of this research. But, equally important I believe, is the fact that solid-state science will be an inherent part of almost everything industry *does* in the future.

Now I would like to discuss briefly some recent and current progress in the development of solid-state electronic devices and their applications. Then I will conclude with a brief mention of a major barrier confronting the scientists working in this field.

Transistors, which are the most famous of all semiconductor solid-state devices, will get some glamorous new applications. One of these will be transatlantic telephone cables, and it seems appropriate that the transistor should be so helpful to the telephone business in this and other ways since it was the invention of the Bell Telephone Laboratories. In 1955, the first transatlantic cable for voice communications was laid, incorporating some 50 "repeaters," each containing three of the most reliable vacuum tubes ever made. The cable is expected to operate without attention for 20 years, and the extreme care given in making each of these tiny repeater stations, now lying more than two miles below the ocean's surface, is represented by the cost of $70,000 per amplifying unit and a total cost of $40 million for the total project including two cables. Now the people at Bell are planning that, in similar projects of the future, the transistor can replace the vacuum tube with even greater reliability and reduced power requirements, resulting in better performance. The difficulties of estimating the possible lifetime of transistors become apparent when it is realized that their discovery was made less than ten years ago.

Of the 12 million transistors manufactured by U. S. industry during 1956, approximately half were used for entertainment, mainly personal, portable radios with some for automobile radios. About one-eighth of the total went into communications service and another eighth into computers and digital devices. The remaining one-quarter had other applications, including hearing aids.

The anticipated growth in transistor sales—25 million this year, perhaps as many as 400 million by 1965—will rely heavily at first on entertainment uses. It can be expected that portable, table and clock radios will be almost 100 percent transistorized. Extensive use in television can be expected, depending on some complicated economic and design factors. Non-entertainment growth will be both military and industrial. One key area is the computer.

Because of small size, low power requirements and

ultimate dependability of transistors, it has been apparent to many people for some time that transistors should eventually dominate the computer field. This has not occurred yet, principally because transistor technology itself is so young. None of the really big "electronic brains" has yet used transistors in large quantities, but some time ago the National Cash Register Company announced a program to build a full-scale electronic computing system that will be fully transistorized, its computer being made for NCR by the General Electric Company. International Business Machines and other leaders in the computer field are also taking leading roles in solid-state research, and semiconductor devices are certain to dominate the computer business before too many years have passed. The giant IBM model 704 computer incorporates some four thousand vacuum tubes and generates enough heat to supply several houses. With transistors, the same machine can be substantially smaller, use a fraction of the power, and eliminate most of the heat problem.

An example of how the transistor may turn up in some unexpected places in tomorrow's world is the report that automobile designers are working on a transistorized fuel-injection system. This appears to be an application never considered for the vacuum tube, but most ideas for the use of transistors involve putting them in places now occupied by vacuum devices. As a result, there is a popular misconception that the vacuum tube is a dead duck and that it will be replaced entirely by the transistor and other solid-state devices.

Certainly the vacuum tube is far from being a dead duck. Even the most ardent booster of solid-state devices must concede that the vacuum tube is well out in front of the semiconductor devices in four key areas: power, frequency response, ability to operate at high

SOLID—STATE PHYSICS

by DR. MALCOLM H. HEBB, GENERAL ELECTRIC CO.

temperatures and tolerance to radiation. In at least the first three of these areas—power, frequency, high-temperature operations—there is every reason to expect significant improvement on the part of semiconductor devices. The major problems to be solved will be discussed shortly. The radiation tolerance of solid-state devices may have certain inherent limitations, but in the other areas there appear to be no theoretical reasons why transistors cannot match many types of tubes. This still does not mean the demise of vacuum tubes, because vacuum technology also is developing rapidly. At the present time, metal and ceramic tubes are being made at the General Electric Research Laboratory that will operate at temperatures ranging from 500 to 800 degrees Centigrade. The best germanium transistors are generally limited to 100 degrees C., and silicon devices can operate in the vicinity of 200 degrees C. There is extensive work in many laboratories aimed at achieving a 500-degree transistor (it undoubtedly will be made of a compound semiconductor rather than a single element), but by the time this has been done, it is fairly safe to assume that tubes will be working in temperatures beyond 1000 degrees. All of this is a nice example of friendly —and healthy—competition in research. For the foreseeable future, there is every indication that both tubes and transistors will become more important. Each has unique features; neither can completely replace the other. The most significant similarity between vacuum tubes and transistors is that both are getting better all the the time.

It is interesting to note that some of the means by which tubes are being improved come from other branches of solid-state science. Improved cathodes and glasses, and the new metals and ceramics are examples.

Semiconductor products actually got to market earlier in the rectifier business than in the transistor business. New solid-state rectifiers have gained wide acceptance, particularly in the chemical industry, but have been slower in breaking into another area where they should eventually have great importance: transportation. A major problem in electric transportation is the proper balance between the efficiency of a-c power transmission and the advantage of d-c motors for high starting torque. Solid-state rectifiers offer the promise of letting the electrical transportation people have their cake and eat it, too. During the past year, germanium rectifiers have been in service in an electric commuting train in England. The reports to date are encouraging.

One can look forward to developments in another direction; just as the vacuum tube diode and triode developed into the many specialized multi-element tubes of today, so will the relatively simple rectifiers and transistors that we now know lead to more complex structures in the future. Of particular interest are devices comprising more than one or two rectifying junctions. An example is a controlled rectifier that might use several such junctions.

The previous mention of solid-state devices that "see" was a reference to a whole family of photo detectors—photoconductors, photo diodes, photo transistors. Because they are relatively inexpensive and have high output, the photo-conductors are coming in for a large share of scientific attention. Recently, RCA announced it is making a highly-efficient headlight dimmer for automobiles. General Electric's X-ray Department uses photoconductors to look through a can of beer to ensure that it is completely full before it leaves the brewery. This can be done faster than detecting a light can by its weight. Other applications of photoconductivity are simplified television-camera tubes, both for ordinary light and for X-rays. There will be many future improvements in photoconductors, and wider applications. But, in the meantime, science has found some slightly more expensive but also more efficient methods of achieving similar ends. These methods are through the use of photo diodes and photo transistors, which have computer applications because they are extremely small, sensitive and fast. Tiny germanium-junction photo-electric cells recently announced by Standard Telephones and Cables Limited in Great Britain are less than a tenth of an inch in diameter and are designed specifically for scanning operations in punched-card and perforated-tape machines.

Solid-state devices can be light-producing as well as light-sensitive. Electroluminescence — the well-publicized

(*Continued on page* 36)

GENERAL TELEPHONE'S FORECAST *

by

Donald C. Power

President

*for 1958

GENERAL TELEPHONE, IN 1958, expects to make a significant advancement in its forward progress. We feel that general conditions, together with our own aggressiveness in merchandising our services, will result in one of the best years in our history.

We feel our plans are justified because of several things. First, the general population of our country is steadily increasing, and the population increase is greatest in the areas in which our operating companies are established. It is the suburban areas, the smaller cities and towns which are getting the big increase in population and business—areas in which we operate.

Coupled with this natural healthy increase in demand for our telephone services by an increased population is the merchandising effort which we are expending. We are learning more and more from our customers as to the types of services they would like from their communications facilities. We are tabulating these results and are planning to fulfill these desires as quickly as possible. And as we supply these additional services they all add to our over-all revenues, in the service fees, in the cost of additional equipment required as homes request additional telephones, and where party lines become private lines.

This increase in telephone service and facilities in the home and in business brings about additional needs for our manufacturing facilities. We have planned well for this by doubling the capacity of Automatic Electric Company, our largest manufacturing company. Automatic Electric dedicated its new plant in Northlake, Illinois, in October 1957, and 1958 will see it operating a complete year with full use of its capacity.

This is a part of our business that we are sure will increase substantially as we go along. The constant increased demand for telephone equipment alone will keep this plant operating at a high level, but in addition to that, we expect to build up a very sound market for general industrial applications of our products. Such organizations as IBM, Sperry-Rand, General Electric, and others have shown a great interest in the application of our products to their equipment, and we are planning an advertising approach that will appeal to those companies where quality of product and certainty of delivery are important considerations.

Many of the products furnished by General Telephone through our own sales organizations are getting stronger and wider acceptance each day. Our electronic secretary, a telephone answering device, is gaining in popularity and proving its worth to telephone users all over the country. The quality of this product is outstanding and its use by the small businessman is proving its value, all of which points to a vast market. Many companies other than those within our own General Telephone System are distributing the electronic secretary widely.

Another product that has a bright future is the Kilburg Dial-A-Phone which will automatically dial for a subscriber his most frequently called numbers. The introduction of direct distance dialing requires the use of a larger number of digits than used for local calls. This machine will automatically "dial" a list of approximately 800 most frequently called numbers, thus saving the task of dialing.

We also expect continued improvement in our General Telephone Directory Company in the sale of advertising space in the yellow pages of the various telephone directories. As the telephone operating companies continue to grow—and the growth in population in our areas will bring this about—the number of businesses within these areas will increase and prospects for advertising will go up accordingly. Also, we have learned that the biggest incentive for yellow page advertising is found in the development of a growing town simply because new people, coming to a new community, count on the yellow pages to help them get the necessary services and products. In addition to this natural growth, the aggressive sales program of the Directory Company has added materially to its growth, and the continuation of this trend will add significantly to our over-all earnings in 1958.

In addition, Automatic Electric Company has a one-third interest in Lenkurt Electric Company as San Carlos, California—one of the outstanding producers of microwave and carrier equipment. Lenkurt has additional plants at Vancouver, British Columbia and Mexico City, and has prospects of continued progress and increase in its business. Our Automatic Electric Sales Corporation distributes Lenkurt products which are finding greater and greater acceptance in the communication field. We feel quite certain that this progress will continue to enhance our over-all operations through 1958.

BURROUGHS SYSTEM STUDIES... MORE AIR DEFENSE INSURANCE

ONCE AGAIN ELECTRONIC COMPUTATION AT WORK HELPS RESOLVE A VITAL PROBLEM

Freezing enemy air assaults at "real time" speed—if and when they should come—is a must of modern defense. And high speed computation applied through a System Study makes this possible.

Suppose, for example, enemy air armadas are jetting in on target from several "o'clocks" at once. How do we gauge their speed, location and relative priority . . . then assign the best available weapon to obtain the kill?

The U.S. Army Signal Corps handed Burroughs Corporation this objective. We examined the military problem and developed a tactical analyzer known as MATABE (Multi-weapon Automatic Target and Battery Evaluator). Using MATABE, Burroughs Corporation is continuing this System Study which will determine the ultimate defensive weapon system.

In such System Studies, again you see Burroughs at work, analyzing and resolving problems for the military—and for civilian industry, too.

Inquiries for further System Studies are welcomed in any and all areas of our proved competence. Write, call or wire Burroughs Corporation, Defense Contracts Organization, Detroit 32, Michigan.

BURROUGHS CORPORATION

THE FOREMOST NAME IN COMPUTATION

"wall of light" to which important contributions have been announced recently by Sylvania and Westinghouse —is essentially the direct conversion of electrical energy into light energy in a solid phosphor film. There is no question but that, with improvements in efficiency, electroluminescence will have an important place in the lighting techniques of the future. We should not forget, however, that even if it can become an economically-efficient producer of light, the "wall of light" has certain limitations. If Edison had invented electroluminescence instead of the light bulb, every research laboratory would be knocking itself out trying to produce an electric light source that "doesn't take up the whole wall and could be put in some compact form—maybe even in a little glass sphere."

Solid-state research *may* have an answer to the need for more efficient light sources that are also compact. I hasten to emphasize the word "may," since what has been observed so far is probably the *least* efficient way ever seen for converting electric energy into light energy. The light to which I refer is emitted from some semiconductor junctions when a current is passing through them. Thus far what has been observed is completely impractical, but the solid-state theoreticians at our research laboratory have guessed that the junction light source just might be the key to getting closer to the theoretical 200 lumens from every watt of electricity, instead of the approximately 20 lumens per watt produced by a good incandescent bulb and the 60 lumens per watt of fluorescent lamps.

An interesting combination of the two solid-state phenomena just discussed—light sensitivity and light production—is a method of controlling electric currents in a manner that cannot be accomplished by ordinary relays or amplifiers. In this system, electrical energy is converted into light by a form of electroluminescence; the light therefrom falls on a light-sensitive photoconductor, producing an electrical current. This sounds like a complicated method of starting out and ending up with the same thing—electrical energy—but it offers certain opportunities that might not be possible by more straightforward methods.

The converse of this system would be to use light to control an electric current through a photoconductor and then convert the electric energy back into light by electroluminescence. A number of systems of this type have been developed under the general description of "light amplifiers." At our laboratory we have developed another method of light amplification that is unique because the amplification and conversion (in this case the conversion of one kind of light energy directly into another kind of light energy) all takes place in a single solid-state layer of phosphor. The most appealing application at the present time appears to be in X-ray fluoroscopy, where amplication and conversion in a simple, thin device would combine a brilliant image for the doctor and minimum exposure for the patient.

Two other solid-state devices recently in the news should be mentioned: the Cryotron and the Maser. A unique feature of the Cryotron, which has been developed by the A. D. Little Laboratories, is that it appears to be the first practical application of a phenomenon called superconductivity which has long been a laboratory curiosity. Superconductive materials actually have no electrical resistance at all at extremely low temperatures—within a few degrees of absolute zero. The Cryotron is an amplifying device that makes use of the superconducting properties of tantalum when cooled in liquid helium. Because it is compact, simple, and inexpensive in construction and consumes very little power apart from the modest power needed to create the very low temperatures, the Cryotron may play an important role in computers.

"Maser" stands for Microwave Amplifier by Stimulated Emission of Radiation. As a spokesman today for solid-state research, I hasten to set the record straight by saying that not all of the Masers developed to date have solid-state devices, although the solid-state Masers appear, obviously, to have conspicuous advantages. Leaders in this work have been scientists at Harvard University, Bell Labs, and Massachusetts Institute of Technology. Applications of the Maser are expected to be principally to the amplification of radar signals and to scatter communication.

Now to discuss a few fundamentals although I am fully aware that gadgets are usually much more interesting to most readers than is fundamental science. Some scientists are inclined to develop mild persecution complexes because "our real work is never reported." It has been pointed out that the Cleveland professional football team got more coverage when it put a transistorized receiver in the quarterback's helmet than Bell Labs did with the original announcement that it had made a transistor. As far as I can see, this is just human nature. and readers will always be more interested in a device they can visualize in practical use than in basic "highbrow" science. (However, the scientist has certain consolations: the Cleveland Browns have won several professional football titles, but Messrs. Shockley, Bardeen and Brattain got a Nobel prize.)

Actually, this apparent apology for what I want to say in conclusion is probably unnecessary, since the only "fundamental" I want to discuss in connection with the future of solid-state physics is not a very complicated concept. This concept is "purity." Purity has one meaning to a preacher, another to a water commissioner, but, to the solid-state scientist, purity has a meaning that is difficult to visualize. Semiconductors are the extreme in their requirements of freedom from chemical impurity and freedom from structural imperfection, such as misplaced atoms. Germanium and silicon are routinely prepared with no more than one part per billion of significant impurities. Thev have been prepared with no more than one part per trillion. Some concept of this last number is given by noting that it is less than one counterfeit dollar in the total national debt.

This critical need for purer materials seems somewhat paradoxical in view of the fact that, in almost all semiconductor devices, there are eventually introduced intentional impurities. However, other impurities must still be vigorously excluded and, to improve practical devices, we must have the understanding that comes from studying extremely pure materials.

To accomplish some of the new things that I have mentioned, it will be necessary to extend the technology now available for silicon and germanium to other materials. It will require the talent and cooperation of several scientific diciplines: physics, metallurgy, chemistry, and others.

To those looking for the big electronics news of the future, I can offer only one word of advice. Keep one eye on the fundamental efforts to produce purer, cleaner materials for solid-state research. This is the "breakthrough" that is needed to produce many of the fantastic electronic devices that have been promised for the future.

IT&T standards laboratory

by Edmond H. Leavey, President
International Telephone & Telegraph Corp.

THE PROPOSED POOLING OF scientific and technological resources by the nations of the free world offers an interesting commentary on the great strides that have been made in international standardization in the broad fields of physics, engineering and industry, without which an easy flow of weapons technology and other scientific information would not be possible.

Standards and precision measurements are, in a sense, the universal language of the scientist. As such, they permit a ready exchange of ideas, provide acknowledged means for conducting and evaluating research, and eliminate duplication of effort, thereby leaving valuable time free for problems yet unsolved. In the technological field, this country's mass production economy depends upon them. Quality control, interchangeable parts, specified tolerances, and the like, *are* the measurement process, and measurement gains its meaning from agreed physical standards.

At International Telephone and Telegraph Corporation, our interest in this work is one of long standing. From the beginning, we have maintained an intra-System standardization program in order that the headquarters staff might successfully direct and coordinate the System's many and varied activities in all parts of the world. In the summer of 1957, we moved beyond the bounds of our own organization with the establishment of the IT&T Standards Laboratory, a new facility for testing and servicing master mechanical and electrical devices. This laboratory offers a convenient service, supplementing and extending that of the National Bureau of Standards, not only to IT&T System companies, but to outside firms and organizations such as universities and scientific foundations, and even United States Government agencies.

Mechanically, the laboratory is equipped to provide certified standard testing of gauge blocks, threaded ring gauges and set plugs, plain and tapered plugs and rings, thread-measuring wires, master gears, precision threaded parts, and cylindrical and tapered parts. It is also prepared to measure contours, circles, surface finish, hardness, flatness, and a variety of other mechanical configurations and qualities.

In the electrical field, the laboratory offers precise measurements of voltage, current, resistance, frequency, capacitance, and similar basic electrical units. Voltage, capacitance, resistance and other standards used are certified by the National Bureau of Standards.

The IT&T Standards Laboratory, which is literally a building within a building, is unique in design. It has been constructed as a separate entity with its own walls, ceilings, and air-conditioning apparatus inside the plant of IT&T's Federal Telephone and Radio Division in Clifton, New Jersey. The walls and ceilings are of steel with special windows that have heat and sound insulating properties. The floor of the mechanical section is a block of reinforced concrete, 12 inches thick and weighing more than 60 tons, resting on a vibration-absorbing material that, in turn, is in a concrete-lined pit in the earth. Flexible material around its edges isolates the floor from the walls and from the factory floor.

Air conditioning with special filters keeps the mechanical room at 20 degrees centigrade and the electrical section five degrees warmer at 25—the recognized standards for each type of measurement performed. Positive air pressure is maintained within the laboratory so all leakage is to the outside to prevent dust from entering. As an added precaution, laboratory personnel don orlon smocks and pass through a de-linting chamber before entering the mechanical section.

Rigid environmental control is essential to the precise measurement work in which the laboratory is engaged. Even slight temperature changes affect electrical characteristics and cause metals to expand and contract. Wave lengths of light, which are particularly well suited to the measurement of small dimensions, are also subject to change in air, depending on the humidity, barometric pressure and temperature.

The emphasis on completely accurate mechanical and electrical measurement is largely the result of modern production methods, which require that parts be built to conform with dimensions or other physical characteristics as defined in a blueprint or specification.

In mass production on automatic machines, however, it is not safe to assume that the cutting tools retain their original sharpness and dimensions, or that the machines themselves remain in adjustment indefinitely. Thus, it is necessary that the work and the tools be checked periodically against measuring instruments calibrated in terms of reference standards to assure compliance with specifications. In time, these instruments may wear and must in turn be checked by master gauges that are used for this purpose only. It is to the testing and certifying of these master gauges and the corresponding electrical devices that the IT&T Standards Laboratory is dedicated.

A typical service is the measurement of small, highly polished metal gauge blocks that are used as "yardsticks" in mechanical measuring. These are certified by their manufacturer to accuracies within millionths of an inch. With a Carl Zeiss, Koester's absolute interferometer—the latest model of its kind in the United States—the IT&T Standards Laboratory can measure the length of these gauge blocks directly by means of light rays to an accuracy of better than one-millionth of an inch.

With other instruments, angles can be measured to within two seconds of arc (1/1800 of a degree), surface roughness in millionths of an inch, and inaccuracies in the pitch diameter of a screw thread to one hundred thousandth of an inch. Electrically, it is possible to measure radio waves up to 600 million cycles per second, and determine electrical resistances as great as 5,000 million million ohms.

Such precision reflects the high degree of refinement to which standardization has been developed. Its growth has been fostered to a great extent by the successful application of interchangeable parts manufacture. Today, the established pattern of spe-

Star track photograph created by time exposure of film while camera was focused on Polaris.

WHAT IS SPACE?

Some 500 miles above the earth, a few solitary molecules of atmosphere are the final "land's end" of our small island in space—the outer reef beyond which lies an immense cosmic ocean so inconceivable that men had to invent a symbol (∞) to denote it.

How vast is this ocean, and what lies beyond our shores?

First, our own sea of stars: This is a giant wheel-shaped galaxy containing some 300 billion stars. Imagine a speck the size of a dust particle on the spoke of a cosmic carriage wheel 1,000 miles in diameter. This is the relative size of our sun, one small life-giving star in the great procession. And beyond our galaxy, at least 100 million more such galactic systems are telescopically visible. The "weather" of this cosmic ocean is composed of strange storms of cosmic radiation, distant clouds of interstellar gas, violent geomagnetic tides and currents, sudden showers of meteoric dust.

It is this weather that we first seek to understand. Much needs to be learned about cosmic rays, the nature of gravity, the physics of light, the true chemistry of "nothingness," the temperature of space, and the movements of the atmosphere on our small island below.

Our first few hundred miles voyage into space will be an infinitesimal step into the 600 billion billion miles of the visible eternity surrounding us.

MARTIN

BALTIMORE·DENVER·ORLANDO

cialization in industry often finds the production of mating parts taking place in several different locations. Nevertheless, these components must be coordinated with regard to size and material so that they fit together and support the designed load no matter where, when, or under what conditions they are made. Oftentimes entire units, as is the case with many defense items, are "farmed out" to a number of manufacturers who must carefully observe duplicate standards for complete workability of the finished product.

Strict adherence to given standards suggests a "freezing" of products or processes into prescribed forms. Actually, the further science advances, the more it depends upon precise standards and measurements for its continued progress. The success of the all-important missile and outer space programs we are now engaged in demands standards and measurements of unexampled precision. Technical advances in industry often require the development of new standards which themselves are the source of research and development projects. The growth of the television industry in the United States, for which standards of frequency, number of frames per second, number of lines per frame, degree of definition, and other technical matters had to be established before any marked progress could be made, is a good illustration of the latter.

The partnership between science and standards and its effect on the technological growth of the United States was stressed by Dr. Allen V. Astin, Director of the National Bureau of Standards, the principal speaker at dedication ceremonies for the new IT&T Standards Laboratory. He pointed out that if the science of measurement and the basic sciences are pursued concurrently, not only will they be beneficial to each other, but they will also contribute more effectively to the Nation's scientific and technological progress. He added that in technological matters the United States cannot afford to be second best because of Soviet competion in the field.

Noting that the demand for the National Bureau's measurement services has far outstripped that organization's capacity, with the result that its direct services to industry are now limited to those activities that can best be performed by or are unique to the Bureau, Dr. Astin said that such highly specialized institutions as the IT&T Standards Laboratory must be relied upon to fill industry's needs.

technological impact of transistor electronics

by J. A. Morton, Director of Device Development, Bell Telephone Laboratories, Inc.

ELECTRONICS IS AN INCREASINGLY important part of modern technology. It merits this distinction because it pervades our economy as water does a sponge. Since electronics has to do with the high-speed transmission and processing of information, it becomes a wonderful extension of man's mind.

Electronics has the potential of affecting every aspect of our modern industrial world through communication, entertainment, transportation, power, manufacturing and business. If we can measure the transistor's effect in expanding the breadth and versatility of electronics, by imaginative implication, we can define its impact on the whole of modern technology.

The bulk of present day electronics has to do mostly with the *transmission* of information. In some 45 years, it has grown from the original DeForest vacuum triode and the development of modulation theory to the fifth largest American industry comprised largely of consumer, military and industrial transmission functions.

For some time now, through applications of information and switching theory to functions such as pulse code modulation, memory, and logic, electronic man has known how *in principle* to extend greatly his visual, tactile and mental abilities to the digital transmission and processing of all kinds of information. However, all these functions suffer from what has been called "the tyranny of numbers." Such systems, because of their complex digital nature, require hundreds, thousands and sometimes tens of thousands of electron devices. The large amount of power used inefficiently and the high cost of reliability of the electron tube have prevented these expansions of electronics in all but a few cases where the high cost could be tolerated, even though not desired.

This is where the transistor comes in. The really important aspects of the transistor are its very high power efficiency at low power levels and its potential reliability. Because of its relatively simple mechanical features, it is potentially low in cost—another basic requirement of "the tyranny of numbers."

So the story of the transistor to date has really been the struggle to realize these potentialities of high performance with high reliability and low cost. Let us take a quick look at the major milestones and problems that have been passed leading to today's transistor technology.

To measure the present and future stature of transistor electronics, we will glance at a few of the many system functions which transistors are now performing or committed to do. These examples cannot be inclusive—there are too many. Most of them will be drawn from the Bell System since the facts are more readily available to the author. But some military, consumer and industrial applications must be mentioned for comparison.

The era from the announcement of the invention of the point-contact transistor in mid-1948 until mid-1951 can be likened to early childhood. In this era, key items in advancing the device technology and research understanding came through the development of pulling and zone melting methods for growing single crystals of germanium of unprecedented purity and uniformity.

Work during this era resulted in improved theoretical understanding and physical realization of the junction transistor with greatly improved performance. Fabrication of junction diodes, triodes and phototransistors was accomplished by both growing and alloying techniques. The micropower, high gain and low noise predicted for such devices was proved.

From mid-1951 to mid-1952, a period reminiscent of adolescence was experienced. Gains in performance encouraged further applications. However, as for an adolescent youngster, so too for the transistor, from day to day we were impressed with new performance possibilities; yet, at the same time, new reliability difficulties were brought to light.

These reliability problems were shown to be surface dependent and a coordinated research-development program on surface physics and reliability was initiated. This heralded the "young manhood" period of 1952 to mid-1955.

During this period, larger responsibilities and definite commitments were undertaken. For example, point transistors went to work in an operator tone dialing trial in October of 1952. The first over-the-counter sales of alloy and grown junction transistor hearing aids took place around the end of 1952. A few years later, no manufacturer produced tube hearing aids.

In March 1953, phototransistors were employed in the card translator portion of direct distance dialing equipment. Tradic, the first transistorized military computer, was demonstrated in January 1954, and in December of the same year, IBM demonstrated its first all-transistor computer using more than 2000 transistors.

Other telephone equipment developed during this era included transistorized combined telephone sets for the hard of hearing and for use in noisy locations, and transistorized rural carrier and line concentrator tests were successfully undertaken.

On the military side, digital data transmission and processing systems, computers and missile control systems relied wholly or in part on transistors for their successful development and trial.

This sudden expansion in applications called for a wide variety of types of transistors. Techniques for germanium were pushed to their limits. Germanium crystals of almost perfect physical and chemical properties were developed to improve manufacturing yields.

Diodes, triodes, tetrodes and power units of a wide variety were developed and manufactured. Silicon entered the field as an alloy junction diode of greatly improved properties; silicon became an important bread and butter business.

Gains in understanding of the surface effects in reliability were put to work successfully in the form of improved surface treatment and capsulation techniques. Reliability surpassed that of all but the telephone tubes. In fact, one hearing aid transistor manufacturer complained bitterly and frequently over the disappearance of his replacement business.

Where then did transistor electronics stand near the end of this era of early manhood?

The wide variety of applications called for a staggering range of characteristics. Point, grown and alloy techniques on germanium and silicon

were close to their capability limits. Each structure and technique had serious limitations. Transistor designers and manufacturers were forced to develop a large number of compromise designs—about 200. A manufacturer's nightmare inhibited large scale economical manufacturing of any one prototype. This was reflected in still high costs—from $2.00 to $45 per transistor.

Meantime, research people everywhere were busy pushing ahead the frontiers of understanding of materials, structures and techniques. Toward the end of this era, they made a triple breakthrough of such magnitude that it started a new era—the "Era of Maturity." This work demonstrated the possibility of removing most of the limitations which forced design compromises to a multiplicity of types.

By proving the feasibility of purifying silicon to transistor requirements, by solving the problems of solid state diffusion as a technique and by developing the diffused base structure, they demonstrated the possibility of making diffused silicon transistors 5 to 10 times faster than the older germanium transistors, while at the same time retaining the silicon advantages of high power, temperature and efficiency. Application of the same structure and technique to germanium pushed the frequency frontier into the low microwave region.

Re-Evaluation

The magnitude of these accomplishments dictated a re-evaluation of our transistor development-application program at Bell Laboratories in mid-1955. It was realized that further refinements of the growing and alloying techniques were possible but only at large development and manufacturing costs. However, the dramatic demonstrations of potentiality of these new techniques, based as they were on more complete scientific understanding, clearly showed that we should devote maximum effort to their development. The eventual economies of a single prototype technique and structure, with heavy emphasis on silicon, were the goals.

Where does Bell Laboratories stand device-wise today?

We have under active development a silicon diffused base triode of 50-100 mc alpha cutoff. It is aimed at covering all foreseeable high speed switching and computer applications. as well as some carrier and digital processing systems.

Complementary to the triode is a pair of diffused silicon switching and computing diodes which should meet all the speed, temperature and power requirements now foreseen. An important part of this same project is the pnpn diffused silicon switch for crosspoint and other switching applications.

For power rectifiers, voltage regulators and lightning protection, a companion line of diffused silicon high power diodes is being developed.

All three of these device classes will use common materials, manufacturing facilities and techniques.

I.F., VHF oscillators and amplifiers for broadband video, carrier, and high-speed pulse code modulation applications are being covered by a prototype diffused base germanium transistor having alpha cutoffs in the range of 1000 mc.

How have these important new techniques affected Bell System applications? Every system area of the Laboratories is affected, but mention can be made of only a few.

In transmission: Pulse code modulation trunk carrier, personal radio paging and possibly broadband submarine cable are depending upon the diffused base germanium devices. Although transistors have not yet invaded the microwave systems area to a significant extent, transistor technology has led to significant improvement in mixer noise and conversion loss, and to a new diffused silicon modulator having gain instead of loss. Such devices are going into the new TH radio relay system.

In station apparatus and power systems: The diffused rectifiers, voltage regulators and lightning protectors are important components for greater success in their design and performance. By applying diffusion to cheap silicon, it has been possible to design a much smaller and better click reducer than had previously been available. This is a device for reducing clicks resulting from operating contacts in the circuits.

In electronic switching: Diffused silicon diodes and triodes are indicated for all logic and control functions.

In the newly established field of data processing and electronic PBX, device requirements are not yet well established, but it seems highly probable that the diffusion devices described will find widespread application here also.

In the military area, too, this new line of devices is gaining acceptance in computers, guidance systems, servo systems, fuses, radar, communications systems and power supplies. In fact, we expect to have diffused base germanium transistors in the earth satellites.

What has been happening in the important commercial world of transistor electronics during this last era?

Most transistor makers have been concentrating on alloy and grown junction germanium transistors, mechanizing their production in an attempt to get prices down, an extremely important factor in the growth of a highly competitive consumer market. Impressive gains have been made to the point that most entertainment and hearing aid transistors are now selling for $1.00 to $1.25. Only a few manufacturers are producing diffusion types.

In consumer and industrial electronics, these commercial transistors are finding their way into a staggering variety of tube and non-tube replacement equipment. To mention a few, the list includes binaural hearing aids, portable radios and phonographs, auto radios and fuel injection systems, portable TV sets and cameras, paging receivers and electronic instruments, computers and machine tool controls, clocks and watches, toys and even a guidance system for a chicken feeding cart.

As of this date, there are approximately 50 domestic and foreign manufacturers of transistors. Production figures abroad are not available, but it is known that essentially every major western nation, as well as Japan, is active. It is believed, however, that they are several years behind the U.S. in application and production. We have no authoritative technical information on Russian production. but Pravda assures us that Russia is well in the forefront—as usual.

In the United States, commercial production figures have grown from some 1.3 million units in 1954 to about 13 million in 1956.

Industry spokesmen predict that 1957 production will be about 30 million units. By 1959, this figure is expected to reach the 100,000,000 mark with larger fractions going into industrial control and data processing applications. The 1965 predictions may be "blue sky," but the unanimity of opinion places combined commercial-military production at the half-billion mark with unit prices less than those of tubes. This prediction assumes that more than half of these units will be used in

(*Continued on page* 50)

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For RCA Communications, Inc.

1958 OUTLOOK

For American Cable & Radio Corp.

Staff Report

TO MAINTAIN ITS LEADING POSITION in the international record communications industry, RCA in 1958 plans to continue to improve and extend the scope of its many overseas services placing special emphasis on the further development of the newer subscriber services — TEX, and Leased Channels. Pioneered and developed by RCA, these two unique communications services have accounted for a steadily increasing portion of the company's total annual revenue during recent years.

Since its inception in 1950 with a single circuit to Holland, RCA has developed TEX service to a network of 66 radio channels now reaching 32 countries on four continents. Through RCA's TEX service, more than 40,000 subscribers in the United States are able to engage in two-way teletypewriter communication with an almost equal number of customers overseas.

RCA has kept pace with the heavy customer demands for TEX service by continuing its extensive program of multiplex terminal installations. Since increased channel capacity gained in this fashion can be used for either TEX, Leased Channel or message telegraph services, RCA has capacity to handle efficiently heavier volumes of overseas communications of all types. In the coming year, this long-range program of increasing circuit capactiy through the use of multiplex equipment, coupled with existing plans for the extension of TEX service to new areas, is expected to produce an increase in TEX traffic of 19%.

Labeled "experimental" only a few years ago, RCA's Leased Channel service today is used by every major U.S. airline flying international routes and by stock brokers, commodity merchants, steamship companies, automotive manufacturers and Government departments. Leased Channel service provides these customers with 24-hour-a-day facilities for direct point-to-point radioteletype communication. During 1958, RCA anticipates that its Leased Channel operations will be increased by approximately 28%.

In the coming year, RCA expects to handle well over 200,000,000 words of telegraph traffic on its 84 direct radio circuits which link the United States with 66 countries throughout the world.

Although automatic equipment now enables RCA to process this traffic with a minimum of delay, RCA engineers are perfecting terminal equipment and devices which will further speed the processing of radiotelegraph messages.

by Ellery W. Stone
President, AC&R

THE AMERICAN CABLE & RADIO Corporation will continue to expand its operating facilities during 1958 to accommodate the steadily growing international telegraph traffic load carried over the cable and radio circuits of its three operating units, All America Cables and Radio, The Commercial Cable Company and Mackay Radio and Telegraph Company.

Included in the program for the year ahead is the widespread application of new high-speed multiplex equipment on radio circuits and a greater use of underwater repeaters on submarine cables, which will increase the message capacity of the A.C.&R. System. The stepped-up operations not only will result in even faster international telegraph service to the public, but also will permit A.C.&R. to offer leased channel service to larger numbers of subscribers desiring overseas teleprinter circuits for their private use.

A.C.&R.'s international Telex service, already available to subscribers in various European and South American countries, and in Hawaii and the Philippines, will be extended to include additional nations in Europe, Latin America, and the Far East during the year ahead. International Telex provides direct overseas customer-to-customer teleprinter service via connecting circuits of Mackay Radio and Telegraph Company.

TECHNICAL MANPOWER

by ***JAMES M. BRIDGES***
Director of Electronics
Office of Asst. Sec. of Defense

UNQUESTIONABLY, A TECHNICAL MANPOWER SHORTAGE has been developing in this country during the past decade, and the shortage will no doubt continue for at least another 10 years. How severe or how critical the situation will become during that period no one can really predict because there are too many unknowns in the equation, one being international politics. The demand for scientists and engineers can be affected radically by changes in international tensions, because this influences the tempo of our military research and development effort.

Perhaps I am overly optimistic, but I believe that we will not have another all-out world conflict during the lifetime of any of us, perhaps even during our children's lifetime. On the other hand, I am not so optimistic as to believe we can avoid another world war without great cost in dollars and technical effort. Eventually, real peace may come to this earth as a result of better communications and understanding among people, but, until that longed-for day arrives, we must prevent war by maintaining such strength of weaponry that we can destroy any aggressor before he can destroy us. The maintenance of this strength will require that military research and development be continued at a high level. This level of effort will probably fluctuate over fairly broad limits as world tensions change — going down when international talk is light and sweet and rising markedly when talk grows heavy and bitter and brushfire wars start.

I believe the best predictions indicate that, on the average, military research and development will continue at about the present levels for some time. This, in itself, would not create a serious shortage of technical people, but the rapidly expanding use of technology in the civilian economy is demanding continually greater numbers of scientists and engineers. Therefore, it appears that the services of technically trained people will be in short supply for many years.

Although we have good and honest differences of opinion regarding whether there really is a shortage of engineers, I can assure you that the general consensus of top people in the Department of Defense is that there *is* one and that it will get worse. I believe that we would have an adequate supply now if the available engineers were used with maximum effectiveness. However, many of us fear that we may be underestimating the number of technical people that may be required to maintain an adequate technical support of our rapidly expanding civilian economy, and that this demand, together with military requirements, will make the ratio of supply-to-demand more unfavorable as the years pass. Also, regardless of efforts made to improve the utilization of engineers, it may be several years before the situation will be substantially improved.

To consider the technical-man-power problem in its true light, we must pause to reflect a little on the changes that have been taking place in our way of life during the past quarter of a century. Actually, we have been going through a period of technological, economic and political revolution which has drastically increased the demand for scientists and engineers and has altered the basic processes and procedures of engineering management.

Our lives are becoming more and more complex along with most of the everyday mechanisms that surround us. More and more of the mental and physical tasks formerly performed by human beings are now done with complex machines. "Automation" has become a commonplace word in the vocabulary of the man in the

street. Because of expanded systems and new methods of communication, we can live this more complex existence and maintain broader and more detailed interrelationships among ourselves.

All this has resulted in an ever-increasing complexity of devices for the home, transportation, communication and entertainment and also of manufacturing processes and machines. Above all, there is a tremendous and continuing growth in the complexity of military devices. I think we could correctly call our present era the "complexity revolution."

It is this fabulous advance in the complexity of living and the technical complexity of devices for living and warring that has created the enormously increased demands for scientists and engineers and has brought about the radical changes in engineering philosophy and management requirements. This has been the primary cause of the present indaquate supply of technical people.

The greatest impact of this "complexity revolution" has been in the field of electronics because this relatively new technology has advanced so rapidly during the last 20 years, even in the past decade.

Technology vs. Management Processes

Our basic problem today is that our technology and the complexity of its products have advanced so fast that our management mechanisms have not kept pace. This is particularly true in military research and development. In recent years, we have placed so much emphasis on the technological problems of developing the weapons and weapons systems we need to maintain our military superiority that we have not thought enough about the management processes required to obtain maximum economy in the use of our funds and technical resources.

To illustrate the effect of the complexity revolution on management processes, consider the changes that have taken place over the years in private transportation:

Not too many years ago, a wagon-manufacturing shop was a typical small business, completely managed and operated by a few individuals who carried out all the basic functions we see in industry today—design, tooling, manufacturing, test, sales and finance. This small group designed each part of the wagon and manufactured it from material which they themselves selected. Utility and reliability were the most important customer requirements, and sales were largely predicated on the day-to-day performance of their product. The management of this business was pretty much a one-man affair, and the communications were by personal contacts, frequently down at the corner store.

In contrast, today's private transportation business is producing an extremely complex automobile with a couple of hundred horsepower, automatic transmission, power this and power that, air conditioning, radio, windows that raise and lower at the touch of a button and steel tops that automatically disappear into the recesses of the body. The company that produces this palace on wheels is an industrial giant, drawing on resources from all over the world to obtain raw materials, employing thousands of scientists and engineers in its various divisions spread all over the country, and subcontracting the design and manufacture of various parts to hundreds of smaller companies.

To draw all this diversified engineering design and manufacturing together into a final assembly requires a vast network of communications and transportation, so complex in itself that it is a major engineering management problem to select, maintain and operate these systems efficiently.

But the point I wish to make here is that the engineering associated with the development and product design of the modern automobile requires an entirely different kind of philosophy in management than our wagon factory had. A new concept has developed—the concept of systems engineering — and the proper management of engineering has become vital to the success of the product.

Even the small companies that are subcontractors for the design of subassemblies are involved in systems engineering because their products may in themselves be complex systems requiring the assembly in individual bits and pieces designed and manufactured elsewhere.

All together, the problems of design scheduling and technical compatibility of design represents a staggering job of systems engineering and engineering management. But it has to be done effectively and efficiently or the result will either be a poor automobile or an automobile that will cost too much; in either case, the competition will take away the customers.

This progression from Old Dobbin's wagon to the over-horsepowered, gadget-laden automobile of today was not revolutionary, but it developed by more or less orderly stages through the "horseless carriage," the Model T, the self-starter and so on. As a result, engineering management concepts in the automobile industry have also progressed in a fairly orderly fashion, keeping abreast of the size and complexity of the job, and the efficiency in engineering management has been motivated by competition and profit.

Unfortunately, these vital factors which resulted in efficient engineering management in the automobile industry are not present to any appreciable degree in our military operations.

In the first place, technical progress in military weapons and weapons systems has been neither orderly nor evolutionary; it has been revolutionary. Technology and operational demands have advanced so rapidly under the pressure or threat of war that weapons under development have frequently become entirely obsolete even before they were ready for production. In contrast to more than 50 years of evolutionary progress from the one-horse shay to the 1958 automobile, we have advanced, in slightly more than 10 years, from a relatively simple antiaircraft gun system to an extremely complex guided missile air defense system. The complexity of such a system and the job of systems engineering and engineering management is perhaps an order of magnitude greater than in our modern automobile. It is not surprising that our management processes have been unable to cope with this radical complexity revolution in weapon development and production. I don't think we could have obtained real efficiency in management even without the impediments of Government regulations and red tape. The change has been too fast and too radical.

In the second place, the motivations of competition and profit have not been present in our military research and development effort to the extent that they are found in industries making commercial products for an extremely competitive market. Certainly, all of us in the Department of Defense are conscious of costs, but it is extremely difficult to obtain the efficiency in management that comes from competition when we are primarily striving for performance which is always against the boundaries of technical knowledge — and when we are buying these complex developments on a cost-plus-fixed-fee basis, sometimes under almost complete Government subsidy.

Unfortunately, it is not easy to develop competition in this military research and development business. Competition results when more than one company develops the same kind of an item for the same kind of use, and the customer can choose between them on the basis of cost and other considerations. The peculiarity of weapons is that they have only one customer, the Department of Defense. So, for competition in research and development, the Government has to pay out extra dollars, and it also demands additional technical resources in industry. This situation is called "duplication of effort," and it is not very popular.

Other influences have tended to decrease our research and development efficiency and, thereby, to use technical resources less efficiently.

The rapidly expanding technological revolution, together with the ponderous job of management, has been accompanied by a changing attitude toward research and development which is creating a demand for more technical man power and more Government R&D dollars.

Not too many years ago, a scientist had to sell new ideas by a demonstration of practical capabilities. Today, consumers are dreaming up new equipment requirements and demanding that they be developed. When this attitude is superimposed upon a society interconnected by rapid communications, each new advance in component performance, materials, design technique or manufacturing process is not only applied to the solution of the single problem at hand, but also points to dozens of possibilities for new developments to perform entirely new functions. This is a geometric progression of potential proposals for new research and development work. Added to this, we have a continually increasing number of proposals for the development of an equipment or system, based on the ideas that a new approach to a component, technique or system is feasible and an improvement over what is now being done.

Although today's military research and development budget is staggering, both in dollars and the amount of technical effort it will buy, it still can be made to appear inadequate. An average research man familiar with the state of the art in any given field and acquainted with military requirements can, in a few hours, outline feasible and desirable military R&D projects which, if initiated, would expand the effort in that field by a factor of from two to ten within a few years.

If the services should start development programs for military application of every new idea proposed—even on every technical breakthrough—we would very soon run our military R&D effort far beyond the total available technical resources of the Nation, to say nothing of the taxpayers' patience. A few competent scientists may make a technological breakthrough which could cost many millions of dollars and thousands of engineering-man years to develop as a weapon or equipment for Service use. Also, the ultimate cost of producing and using the equipments and systems developed on such an expanding program would similarly increase.

The problem of military management is not so much to determine what can be developed successfully, but to determine what developments are essential to maintain our Nation's security and how many of the essential developments can be achieved within the limits of our national economy and technical resources.

Obviously, a point can be reached in this business where adding more dollars and initiating new projects will merely be trying to buy what does not exist. We must be on guard against this, because people are always willing to accept more dollars and take on more work. The hard question for us is this: When will we reach the point at which we are no longer buying real scientific brain power and good engineering talent, but are accepting the substitute of a degraded engineering standard and mediocre design? We will certainly learn the answer when developments prove unsuccessful or the finished products prove excessively costly or unreliable—or even unusable. But this takes several years, perhaps as many as five, and then it is too late.

By now you may be wondering if I have been evaluating the real problem of using technical man power properly or evading the issue. You may have formed the opinion that I am trying to make excuses for the admittedly inefficient management of military research and development, both by the Government and by industry. This was not my intention; I have merely been trying to establish the fact that (1) the problem of managing this vast R&D effort is extremely complex, (2) that there are many factors entirely new to management which have no parallel in strictly commercial industries and (3) that all these factors have confronted the military services and industry so fast that we have not yet been able to find the management tools to handle the job.

How to achieve more economy—both in dollars and technical man power—in the conduct of military development and engineering effort is perhaps the most urgent matter that we face today. We must seek out the real causes of inefficiencies and do whatever is required to eliminate them.

This is going to take some real soul-searching and the exercise of some real objectivity by both industry and the military departments. We must determine the motivations and incentives needed to encourage efficiency in our methods of program management.

Committee Studies Problem Areas

The Committee on Technical Man Power Utilization has been established by the Secretary of Defense to study the extent to which current policies and procedures concerned with the design and development of military materiel impair the efficiency of technical man power utilization in the industries serving the Department of Defense. The responsibility for forming this committee and directing its activities has been assigned to the Assistant Secretary of Defense for Research and Engineering.

The committee is considering those problem areas in which corrective action can be expected to promote the most efficient use of technical man power in the execution of design and development projects and programs. Among the items being studied are: *Engineering Records*, particularly requirements imposed on industry for drawings and specifications which lead to ineffective utilization of technical man power in design and development; *Contractual Practices* involved in the selection of design and development contractors by bidding and other methods which tend to dissipate technical man power resources in industry; *Technical Administration of Design and Development Contracts* to include the wide variances that exist in industry in the use of engineers and other technical people on similar projects or contracts and the extent to which technical man power is wasted by unrealistic classification and processing of engineering changes.

Thus far, it appears that contracting and program management procedures are the most important. Although these studies have not progressed far enough to permit us to state final conclusions, certain management factors influencing the efficiency of the R&D effort are becoming

fairly evident.

For instance, nothing in our present contracting processes appears to provide incentive to a contractor to obtain a high level of program efficiency. As a result, about the only control the military agencies have is in withholding further R&D contracts from a company that has consistently demonstrated poor efficiency.

But the problem is to determine whether the conduct of a particular program has been wasteful of technical man power and dollars. An engineering job may be completed successfully on schedule and the product may be satisfactory, but the cost is often completely out of line because the "mass engineering" approach was used and there was no management accountability for engineering effort.

The technical project managers in the military offices generally do not know enough about engineering management to recognize poor efficiency in the conduct of the projects they direct. If technical progress appears to be good and schedules are met, they are usually happy, even though engineering effort and cost may be completely out of proportion to the results.

A most effective step toward obtaining improved efficiency in our military R&D work would be to increase the capabilities and the authority of our military technical project officers. This will require that (1) the ceilings governing the number of civilian engineers in these offices be increased, (2) Civil Service pay scales for these jobs be raised, (3) more stringent requirements for experience and training be placed on technical project officer positions and (4) top military management give more authority to the project officers and recognize their importance.

Unfortunately, the tendency has generally been in the opposite direction. Ceilings have recently been reduced in project offices throughout the departments, and attempts to increase the Civil Service stature of these technical positions have been unsuccessful, although strong supporting recommendations were made by the Cordiner Committee.

Another way in which military management of R&D effort should be tightened to improve economy and conserve technical man power is through more careful and critical selection of new projects and by terminating projects that are no longer essential to national security or do not hold promise of successful completion. Definite steps to screen R&D programs more critically, taken by the Services, will result in a substantial reduction of effort on unessential programs and a corresponding increase in activity on urgently needed weapons and weapons systems.

Since much more emphasis is now being placed on obtaining better management of research and development programs throughout the Department of Defense, I am confident that we will see a continued improvement in efficiency and economy in the military direction of our R&D effort. But, in the final analysis, it will be the responsibility of industry in managing these programs that will determine whether the research and development essential to national defense can be carried out with the funds and technical resources available. Industry must make certain that maximum economy of engineering and scientific man power is achieved in its management of individual R&D projects, and I believe that there is room for a great deal of improvement.

Western Union Looks Ahead

(*Continued from page* 28)

5. *Private Wire Growth*

Revenue from the leasing of private wire and facsimile services, approximating $37,000,000 in 1957, reached a new high. Installation of a new, high-speed automatic private wire system for the United States Air Force began late in 1957 and is scheduled for completion by the end of this year. Designed by Western Union engineers, this highly automated system can, in the words used to portray computer capabilities, "read" instructions, act on them, intercept and store communications. It can also recognize, store and act upon instructions concerning message priority or urgency and it can generate and forward multiple copies, as instructed. In short, it can "think" for itself.

Capacity of the new system, the world's largest, will exceed two and one-half billion words annually. This is three times more than the capacity of the system in use by the Air Force in the period immediately following World War II. The increased volume will be handled by only 480 operators, compared with 1,300 formerly required for one-third the load, releasing for other military requirements more than 1,700,000 Air Force man-hours annually. Similar automatic communication centers are being engineered by Western Union for the U.S.A.F. overseas bases.

6. *Expansion of Automation*

As we look ahead, one of the developments that will doubtless play an increasingly important role in the continued growth and expansion of our economy is automation, of which data processing is one important phase. Integrated data processing, or IDP, has created great interest in telegraph communication equipment since no IDP program involving distant or widely-scattered locations can be successful without a fast, dependable communication system.

Our engineers have developed wire systems to meet a variety of data processing needs and Western Union is also using its own public message network for the automatic, high-speed transmission, by perforated tape, of company payrolls, equipment inventories and other operating functions. Such data from every major city are quickly assembled at special centers for electronic processing by business machines and calculators. This makes possible better operating efficiency and more effective management controls.

Western Union's public message network has a tremendous capacity for handling data. It may be possible, in the future, for customers having direct connections with the telegraph network to transmit data nationwide.

Western Union is doing extensive research in the data processing field to determine the future requirements of business. Methods have been developed for accommodating present systems to such requirements as low-cost, high-speed transmission capacity circuits, automatic error detection and correction, acceptance of various computer codes and adequate means of pickup, distribution and delivery to and from customers. Significant progress has also been made in sending data from punched tape at one location into a master computer at another location for instant processing.

Incidental to meeting the many new technological problems involved in handling digital data at high speed, transmission measuring instruments have been developed by our research engineers. Interest has been expressed in them by both military and computer groups. Special models of some of these instruments have been designed and produced for military high-speed information transmission systems such as SAGE.

Research is under way in Western Union on a wide variety of services and other subjects which space does not permit me to review. Many of these projects are related to automation techniques aimed at getting present jobs done faster and more efficiently. Our continuing objective is to perfect present services and develop new, useful services to meet growing public needs in record communications.

RCA's Contribution to Defense

by Arthur L. Malcarney, V. P., Defense Electronic Products, RCA

ON LAND, AT SEA, AND IN THE AIR, THE SCIENCE OF electronics has revolutionized the art of warfare. A preview of the new era of military electronics was provided recently by a test firing of a Talos Defense Unit at White Sands Proving Ground, in New Mexico. TDU, a ground-to-air missile control system designed by Radio Corporation of America, has been aptly described as going a step beyond push-button warfare—because no buttons are needed to send the weapon into action.

The Talos unit is composed of three structures. One is a long, low concrete and steel building containing the control center, and the other two are circular magazines with the launchers, resembling anti-aircraft guns, in the center and numerous cells on the perimeter to house the missiles themselves.

Here's what Talos can do:

Suppose a fleet of enemy bombers, or perhaps a single missile, is detected by one of the numerous warning systems spanning the North American continent. A signal is sent to the TDU, where it is received by a series of data-handling and computing machines. These decode the information and analyze the number of attackers, their location, course and speed of approach.

Next, a scheduling and programming computer sets the logical points of interception. Then it starts the machinery to load the missiles onto the launchers and fire them at the proper time and in the proper direction.

In this stage—still without the lifting of a human hand—the blast-proof concrete-and-steel cell doors swing open to release the missiles the computer has selected. One of the launchers sends a small cart down a railed bridge to the door. Swiftly, the missile is loaded on the cart, rolled onto the launcher, and swung to the desired position of fire. After an automatic check-out the projectile is fired. A guidance beam leads Talos to the vicinity of the target. As it approaches, a secret "homing" device senses the presence of the target and "locks on" to close in for the kill. During all of this action, the military personnel at the TDU merely observe and monitor the performance of the equipment.

A few years ago, this description would have sounded like science fiction. Yet even today military electronics, as we know it, is at the beginning of its development. Change is rapid and constant, but several distinct trends can be seen.

In the past, separate and more or less independent electronic devices served for navigation, control, target detection and communication. Now an aircraft or a missile has become one with its electronic elements. Both are merged into a single system for a desired objective.

The systems concept was born of necessity. Ours is an age in which new dimensions of flight and speed exceed the limitations of the human mind and body. The speed, versatility and performances of modern military equipment require automatic controls which only electronics can provide.

The increasing importance of systematized electronics is clearly reflected in the military budget. Five years ago, defense electronics spending amounted to some $700 million. In 1956, it approached three billion dollars. By 1965, it is expected that this figure will more than double. During the same period, only a nominal increase in over-all military spending for major procurement is indicated, barring all-out war. The increasing emphasis on newer weapons—which will rely even more extensively on electronic controls—assures military electronics a burgeoning share of the total military budget.

The first role of electronics in warfare was simply communication. Today, it serves virtually every aspect of military science. Modern military electronics systems include individualized equipment for communications and navigation, pocket-sized walkie-talkies and television cameras, mobile and airborne television, infrared devices, specialized types of radar for numerous applications, and comprehensive electronic control systems and devices for gunfire, guided missiles, and aircraft.

The successful development and application of transistors, miniaturized components and complementary electronic circuitry also have increased the usefulness of electronics to the military. From this advanced state of the electronics art have come innumerable miniaturized electronics systems and devices which pack more power, punch and versatility. Electronics in space-saving packages are typified by pocket-sized two-way transceivers, tiny radio receivers which can be mounted in a helmet, TV cameras which fit in the palm of the hand, and a host of airborne communications devices which fit into the modern aircraft's crammed equipment complement.

Military electronics is advancing into the future along two seemingly divergent avenues of development. One leads to increasingly complex and comprehensive electronic systems, exemplified by the Talos Defense Unit, which can automatize broad ranges of military operations. The other avenue leads to smaller and more versatile electronic instruments and devices, typified by miniaturized helmet radios, pocket TV cameras, and transistorized airborne communications equipment. These increase the hitting power of the individual fighting man and heighten his defensive protection.

Whether complex and systematized or basic and miniaturized, modern military electronic equipment share a common ingredient—built-in reliability. The chain-like operation of large electronic systems makes it imperative that each element of the system have the advantage of highest quality components, precision circuitry and advanced reliability design techniques. Additionally, progress in reliability now makes it possible to fortify complex equipment with built-in test systems for virtual automatic self-checking of operating efficiency. Reliability is an equally vital requirement in miniaturized devices, particularly in those which have little or no margin for maintenance. Advances in the development of miniaturized plug-in components and sub-assemblies for quick replacement equip such devices for long service life at peak reliability.

The importance of electronics in military operations was clearly established during World War II. It was foreseen earlier by men such as Brigadier General David Sarnoff, now Chairman of the Board of RCA.

Three decades ago, in a 1927 address before the Army War College in Washington, General Sarnoff told his audience:

"Perhaps it would be too fantastic to consider the part that may be played by direct television in the war of the future, but it is too early to consider the direction which laboratory research should take in its application to military uses. It is conceivable that a radio-television transmitter installed in an airplane might be useful in transmitting a direct image of the enemy's terrain, thus enabling greater accuracy in gunfire."

By 1937, RCA engineers built and successfully tested the first television system designed specifically for aircraft use. This system was the forerunner of the first military television system actually to be tested in combat—the famous "Block" equipment successfully employed by our air services in experimental remote-control attacks on targets as widely separated as Rabaul, New Britain, and Heligoland, off the coast of Germany.

"Block I," the first airborne project, was delivered to the Army in April, 1941, for flight testing. It was prepared for use in guiding glide bombs and in radio-controlled bombers. Experience gained in the test resulted in a modified model known as "Block III." During the final stages of the con-

flict, the heavier, longer-range "Ring" system was developed by engineers of the National Broadcasting Company, in conjunction with the U. S. Navy. It was designed for reconnaissance use in heavy planes.

For more than three decades, RCA has been an active partner in national defense. Its contributions include such projects as: radar, Loran, Shoran, Block I, Ring, radar altimeter, weather-detection radar, fire-control systems, guided missiles, military TV.

Electronics research for defense has also produced innumerable developments of benefit to the nation's civilian economy and welfare.

During World War II, RCA was called upon to handle a variety of important radio, television and electronic projects for the Armed Services, including the now famous systems of Loran and Shoran, airborne television and airborne radar. A number of these electronic projects developed into peacetime applications.

Loran systems had wartime use as electronic aids to long-range navigation aboard aircraft and surface ships. Today, Loran equipment is utilized by the Air Force and by commercial transatlantic airliners.

The highly effective system of radar known as Shoran (SHort RAnge Navigation), which was employed with devastating results in blind bombing during the latter stages of the war, becomes in peacetime a new radar "yardstick" for world mapping—so perfected that it can measure distances up to 250 miles with almost pinpoint accuracy.

Shoran, for example, recently provided "seven-league boots" for one of the most extensive land-mapping projects ever undertaken. The system enabled Canadian Aero Service Limited to complete in only four summers a geodetic and photographic grid survey of more than a half-million square miles of the Canadian Far North—a project which would require decades with usual mapping techniques.

The radar altimeter created by RCA research engineers was destined to become of major importance to the allied military and naval air forces throughout the world, and to commercial aviation.

Previously, altimeters provided pilots with information regarding their altitude above sea level. The radar altimeter provides continuous and instantaneous readings of absolute altitude over terrain, with a high degree of accuracy up to 40,000 feet. It enables the pilot to obtain continuous information regarding both his terrain clearance and the nature of the terrain over which he is passing. It makes possible barometric readings from aircraft.

The radar altimeter is used today in both military and commercial aircraft.

With the end of hostilities, research in the electronics laboratories was directed to the refinement and improvement of wartime developments, and to the exploration of electronics possibilities glimpsed during the wartime experience and shelved in the press of military necessities.

Military electronics began to take on a broader meaning, to include ground-based radars for air search, weapon-control systems and guided missiles. The result was intensified research in military electronics and major advances in equipment and systems for commercial applications as well. Typical of these is the RCA weather-detection radar system now widely used by American and foreign commercial airlines and numerous business and private aircraft.

A lightweight airborne radar, the weather system enables pilots to see storms up to 150 miles ahead and avoid them. This highly accurate "in-flight" weather reconnaissance permits commercial pilots to navigate between storm cores, maintain flight schedules and provide smoother rides for passengers.

In the years since World War II, aircraft have become so fast and responsive that they are actually beyond human control. Fortunately, electronic developments in airborne communications, navigation, and control equipment and systems have kept pace with modern aeronautics. Today, no one relies solely on his judgment in flying a plane. Whether in military jets, commercial airliners or private aircraft, the skill to fly is man's, but the controls used are electronic.

The history of warfare is grim with chapters of battles lost and nations humbled by the lack of vision—the vision of a probing eye. Hannibal crossed the Alps undetected until too late. Custer's attack became a last stand because he could not see the ambush in the gulleys. Pickett's men swarmed up the grassy slopes of the Gettysburg hills to discover in disaster the true strength of the entrenched defense.

The science of electronics has given the modern Army new vision—countless electronic eyes which can be turned out on the production lines in quantity. Tomorrow's battles, should they come, will be guided and maneuvered through the seeing eyes of military television.

Three years ago this summer, at Fort Meade, Maryland, combat television was publicly demonstrated by the U. S. Army Signal Corps and RCA. It was evident that the military and electronic sciences had once again collaborated on a development of inestimable value to national security and defense. In color and black and white, with hand-carried, jeep-conveyed, and airborne television cameras, details of the maneuvers were transmitted to a receiver-equipped command post. Watching through the eyes of television, the commander was able to see and control the battle situation as it changed and developed.

While the black-and-white equipment demonstrated the capabilities of television in helping to direct battle action, the color telecast provided a glimpse of the ultimate goal—a combat television system that will provide the commander with a view that includes the color distinction between different types of terrain and foliage, between natural and camouflaged objects, and between the wide variety of colored markings and signals used by friendly and enemy forces.

Only a decade ago, the "Electronic Age" was a visionary, futuristic era in which fantastic devices performed tasks beyond the scope of imagination. Many of these machines and devices already have achieved reality. More are on the way. The electronically controlled weapons of tomorrow are in the development laboratories and on the test ranges today—representing both the deterrent strength we hope will prevent war, and the retaliatory striking power for meeting decisively any emergency which may come.

In a few years, electronics has revolutionized the science and concepts of national defense. But today rapidly becomes yesterday in this fluid, dynamic age. Technological progress depends on electronics, and herein lies the challenge to the industry.

The electronics industry has lived with challenges from its inception. Its achievements—ranging from Radar, Loran, and Shoran, to today's Talos Defense Unit, fire-control radar and guided missiles—prove its ability to meet and anticipate the needs of our Armed Forces. Electronics will continue to help us maintain the deterrent strength we need to prevent war.

Transistor Electronics

(*Continued from page* 41)

non-entertainment applications not now covered by tubes.

What of future Bell System needs?

In 1954, only a few small solid systems were under development at Bell Laboratories. Since then, many new large systems have gotten under way to the point that today, solid state developments are occupying the efforts of a large part of our Bell System development effort, and the fraction is still growing. All of these systems are scheduled for manufacture before or by 1965. Best estimates of the demand for only those systems now active indicate an ultimate yearly level of approximately 100 million transistors and a more than equal number of diodes. While these figures may not be fully reached by 1965, I believe that shortly thereafter, the Bell System will be one of the largest users of transistor electronics.

A MESSAGE FROM THE EXECUTIVE VICE PRESIDENT

★ ★ ★ ★

Greetings and heartiest good wishes for a happy and prosperous New Year! Looked at with genuine optimism and treated with vigor and enthusiasm, 1958 will be a wonderful, never-to-be-forgotten year.

High on our list of important things for 1958 is our AFCEA Yearly Convention, which will be held at the Sheraton Park Hotel, 2600 Connecticut Avenue, Washington, D. C., on 4, 5 and 6 June. Fellow AFCEANS, this is YOUR Convention, and I urge that you give it your wholehearted support in every practicable way.

How to support the Convention? First of all, plan to attend and to bring the family if you can. Not only will there be about 150 exhibits and from nine to sixteen professional papers or forums, but also the main banquet, an outstanding buffet dinner with entertainment, two luncheons, one or more tours to interesting places in the environs of our Nation's Capital, a planned schedule for the ladies, and a prime opportunity to see old friends and to make new ones. This is an unexcelled opportunity to combine business and pleasure in a most profitable way.

Second, your voice and actions can help in the matter of obtaining sponsors for exhibits, arrangements for which are being handled by William C. Copp and Associates, 72 West 45th Street, New York, N. Y.; and of encouraging the submittal of outstanding professional papers of from twenty-to-twenty-five-minute delivery time on subjects of distinctly current interest and with a communications, electronics, or photographic flavor. In this latter connection, we encourage the submittal to National Headquarters of papers on technical subjects as well as papers dealing with methods, management, operation, and the like. February 1st is our suggested deadline for a 50-100-word abstract and March 1st for the finished papers themselves.

So earmark 4, 5 and 6 June on your calendar. Look for more Convention data, which will be published from now on, and feel free to send in your comments and recommendations, on Convention and all other AFCEA matters.

W. B. "Bill" Goulett

★ ★ ★ ★

ABOUT JUNE 4, 5, 6, 1958

U. S. Air Force Photo

"Moby Dick" high altitude research balloon being launched from a special protective trailer at AFMDC. This balloon carries instruments up many miles. Small sized balloon alongside provides launch crew with information on surface wind velocity and direction.

SCIENTISTS ARE OPENING DOOR TO OUTER SPACE AT AIR FORCE MISSILE DEVELOPMENT CENTER

Almost 4000 square miles of desert comprise the rocket and missile test range at the Air Force Missile Development Center at Holloman AFB, near Alamogordo, New Mexico. In another sense, the test range is limitless, extending upwards to the reaches of space. It is one of AFMDC's missions to extend our knowledge of these extreme altitudes, to prepare man for life above the atmosphere—this in addition to extensive development and test work with missiles and similar weapons.

AFMDC is one of the centers of the Air Research and Development Command. In addition to its basic mission, it works with other ARDC centers, government agencies and industrial contractors in electronics, weapons, and upper atmosphere research.

Undergoing tests at AFMDC are surface-to-air and air-to-air supersonic missiles for intercepting hostile aircraft; air-to-surface missiles; surface-to-surface guided missiles, and many similar weapons.

Instruments and biological specimens are carried skyward in experimental rockets and balloons at AFMDC for studies of radio wave propagation at high frequencies; investigation of electrical characteristics of the ionosphere and composition and acoustical properties of upper atmospheres; studies of the intensity of radiation from the sun, from nocturnal space, and from the earth; studies of high altitude winds, and studies of the biological effects of cosmic radiation and reduced gravity. This high altitude research is useful in the development of missiles, aircraft, and associated equipment.

Gleaning this useful information is a long and difficult business which draws upon the skills of thousands of civilian and military engineers and their many counterparts in private industry. The efforts of this small army of technicians will not only determine America's ability to meet potential aggressors, but bring ever closer the coming Age of Space.

This is one of a series of ads on the technical activities of the Department of Defense.

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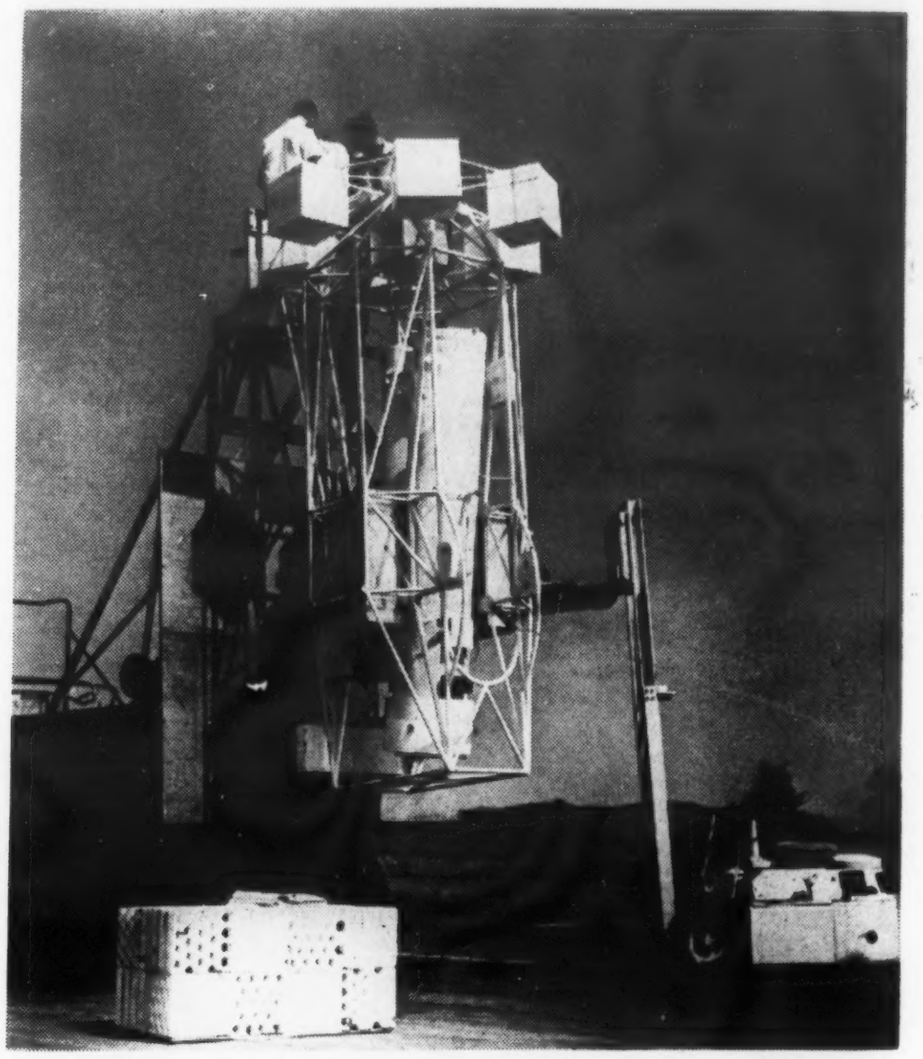
Technicians in Ford Instrument's gyro laboratory perform tests on subassembly from missile guidance system.

photoprogress

by FRANK SMITH
PHOTO EDITOR
SIGNAL



Project Stratoscope Equipment

Navy Project Stratoscope Photographic Instrumentation

A unique application of photographic instrumentation has been disclosed in a recent news release from the Office of Naval Research, Washington 25, D. C.

The instrumentation referred to is the camera equipment of project Stratoscope, a balloon borne telescope, which is designed to make possible a series of high-altitude studies intended to secure further knowledge of the sun, moon, planets, stars and spiral nebulae. The initial flights are planned to secure high quality photographs of the sun.

The Stratoscope system consists of a giant unmanned polyethylene balloon which carries a powerful, specially designed, twelve-inch astronomical telescope coupled with a 35mm motion picture camera and a light-sensitive pointing mechanism, to heights of at least 80,000 feet. When the balloon has risen to sufficient height and the telescope is oriented to face the sun, the camera takes approximately 8,000 photographs at the rate of one per second.

The atmosphere is a most troublesome obstacle in securing good celestial photographs. Since the Stratoscope telescpoe is above at least 90 percent of the earth's atmosphere, the resultant photographs should be at least three times sharper than any taken previously.

The Stratoscope solar telescope has an aperture of 12 inches, is 9½ feet long, and weighs approximately 350 lbs. It was designed and built by the Engineering and Optical Division of the Perkin-Elmer Corp., Norwalk, Conn.

The primary element of the telescope is a 12-inch aperture of f/8 quartz mirror, three inches thick and weighing 28 lbs. A unique feature is the Newtonian secondary quartz mirror which is mounted on a swinging arm so that it remains in the sun's image only long enough to obtain a photographic exposure. The mirror rotates once every second and actually is cooling about 98 percent of the time. This arrangement is necessary so that the mirror will not be distorted nor have its aluminized coating burned off by the solar energy concentrated on it by the telescope's primary mirror.

On a recent successful ascent over New Brighton, Minn., the balloon carrying the telescope ascended to a height of 81,000 feet and some 8,000 pictures of a segment of the sun (50,000 by 75,000 miles of its surface) were taken. Objective of the ascent was to obtain photographs of the turbulent gas storms boiling on the sun's surface. Examination of a small number of the photographs disclosed, among other things, that many of the large storms broke down into clusters and that the smaller clusters were much hotter than the larger ones. These photographs form the clearest, sharpest close-ups of the sun ever taken from the earth and will provide a wealth of astronomical information.

Dr. Martin Schwarzchild, Astronomer of Princeton University, is the chief investigator for the project.

Infrared Photo Reconnaissance System

The effectiveness of infrared reconnaissance as a military weapon is strikingly revealed in a series of infrared photos recently declassifield by the U. S. Air Force, taken with an early system designed and manufactured by Servo Corporation of America, New Hyde Park, N. Y.

These thermal mappings of military ground installations, air fields, and civilian sites show the fantastic ability of infrared techniques to translate into a photo pattern the warmth radiated day and night from the ground target.

In a photograph of Idlewild Airport (N. Y.), the runways stand out as "hot spots." These are areas which have absorbed the greatest heat from plane engine exhausts, friction of moving planes, auxiliary trucks and bright runway lights. As a result, they generate more infrared radiation and appear as the bright areas. The darker areas are radiating less heat.

The Servo system is said to be so sensitive that it can "feel" out the warmth of an object even if blinded by camouflage on the ground.

This great sensitivity of the infrared system is revealed in another photograph taken from a plane flying at an altitude of 3000 feet. Here, the system spotted

maneuvers in a heavily wooded area. In spite of total darkness, the photograph taken with the infrared system showed clearly a road, a tank, its track, forest and a meandering river.

Every inanimate and animate object emits infrared radiation as a function of its temperature. The hotter an object, the greater the amount of infrared radiation generated. In all these pictures, the bright areas indicate the areas of greatest activity while the darker areas reveal a lesser degree of heat. From a military standpoint, this means that heavy industrial areas and specific targets such as factories, railroad yards, airports, etc., can be readily spotted by infrared reconnaissance.

Another important characteristic of Servo's infrared reconnaissance systems are their ability to remain coordinate; they cannot be jammed by electronic countermeasures. They are effective day and night and do not reveal their position.

3M Brand Microfilm
Reader-Printer

Microfilm Reader-Printer Prints Enlargements In Ten Seconds!

A revolutionary type machine that prints enlargements from microfilm automatically 6 to 18 times faster than any other known method has been announced by the Minnesota Mining & Mfg. Co., Duplicating Products Division, St. Paul, Minn .

Called the 3M brand Microfilm Reader-Printer, the machine is both a reader and a printer in a single unit, and is said to be the first printer to be completely automatic, eliminating hand-processing of prints.

It projects microfilm on a viewing screen in the usual manner for reading, then makes a ready-to-use print in less than *ten seconds* when a button is pressed.

The machine prints by an automatic electro-chemical process on a special white paper, 8½" x 11" or 8" x 10½" and operates on 110 volts A.C.

It can be placed anywhere in an office—table, desk, etc.—requires no water, darkroom or other special facilities. The only requirements for operation are inserting the roll of print paper as needed and pouring in a half cup of developing chemical. The chemical is 3M brand microfilm print developer and the paper is 3M brand microfilm print paper.

The Reader-Printer is supplied with a lens for either 16mm or 35mm film, or both. It measures 25" high by 17" by 19" and weighs 85 lbs.

The speed and simplicity of automatic printing as embodied in the machine is expected to solve a major problem of making copies from the files quickly and easily when needed.

Price of the machine with one lens is $629.00; microfilm print paper in rolls of 250 prints are 7½¢ to 8¢ per print.

New Sub-Miniature Cameras for Surreptitious Photography

For those occasions when it may be necessary to obtain photographs of persons or things unobserved, Silver Bells, Ltd., of Seaside, Calif., has provided a neat answer in the form of a "fountain pen" camera and a "cigarette lighter" camera.

The new sub-miniature "fountain pen" type from France, called the Stylophot, is just a little longer than one's forefinger and uses standard 16mm or double 8mm black-and-white or color film in daylight loading magazines. Stylophot is equipped with an eye-level, optical viewfinder with 10 x 10mm image. Shutter speeds are 1/50th sec. for the standard model and 1/75th sec. for the deluxe model. Shutter winding and film advance is combined and automatic. It has double exposure prevention and an automatic exposure counter. Size is 4½" long; weight, approximately 3 ounces. Perfect black-and-white enlargements up to 7 x 7 inches are claimed. The standard model is equipped with double-element, coated, 27mm f/6.3 micro lens and case, and is priced at $12.95. The deluxe model with Roussel Anastigmat, coated, 27mm f/3.5 lens and built-in flash synchronization (standard or electronic) is priced at $24.95.

The second aforementioned camera is called the Echo 8, and is stated to be a high-precision made, superior quality camera contained within a regular, working, windproof Zippo-type cigarette lighter. It is equipped with a coated, 3-element, fixed focus, 15mm Echor lens, f/3.5 with aperatures of f/3.5, f/4, f/5.6, f/8 and f/11 and focusing from 3 feet to infinity. The body is all steel with optical reflex viewfinder. Shutter speed is 1/50 sec. and "bulb." It has automatic film advance stop, and uses 8 mm film in special daylight-loading magazines with 20 exposures. The negative picture area is 6 x 6mm. Weight: 5¾ ounces. Size: 1¾" x 2¼" x ¾". Price is $19.95 with filter and four magazines.

Those photographers who are addicted to the art of candid photography will surely welcome these cameras, since in no other way can a truly candid shot be made except by surreptitious means.

Some New Items of Professional 16mm Motion Picture Equipment

(1) Bell and Howell Co., 7100 McCormick Road, Chicago 45, Ill., is introducing a spool-loading electric eye 16mm motion picture camera, called Model 240EE, to joint the magazine-load model introduced by them last year. In both cameras an "electric eye" or photoelectric cell automatically turns the lens to the proper exposure setting for the light available.

In addition to its completely automatic exposure control, the new camera features a long 32-foot spring run and the first completely automatic threading.

The camera has 100-ft. film capacity, single-frame, continuous-run lock and a versatile range of camera speeds from 8 to 48 frames per second.

(*Continued on page* 56)

ANNOUNCING

VARIABLE VACUUM CAPACITORS

Actual size illustrations

IN HIGH ALUMINA CERAMIC ENVELOPES FOR LOW LOSS AND HIGH TEMPERATURE OPERATION

The three capacitors illustrated are product of a design and development project which has established a *break through* into higher practicality for variable vacuum capacitors. They have great appeal in applications where technical, physical and cost factors have heretofore been prohibitive. There are at present three *size groups,* each of which contains several types differing in capacitance range and voltage ratings.

The art of adjusting the position of elements within vacuum sealed electronic devices by use of a bellows arrangement substantially predates World War II. In this new range of capacitors UNITED ELECTRONICS has advanced this custom through associating it with the newer techniques of ceramic bodies as employed in modern miniaturized and ruggedized electron tubes. Ceramic to metal closures are doubly important in variable vacuum capacitors since moving internal parts are involved. Extremely close tolerance assemblies are made possible under conditions of high production mechanization.

Modern miniaturized circuitry, whether in air, liquid or in rigid encapsulation, will invite advantageous opportunities for these new ceramic VariVacs available in voltage ratings of from 1,000 to 25,000, and with maximum engaged capacitance values up to 500 uuf.

VARIVAC

The above Trade Mark symbolizes Variable Vacuum Capacitors by UNITED ELECTRONICS

Write for technical bulletin CDB-4

UNITED ELECTRONICS, 42 Spring Street, Newark 4,. N. J.

The new camera is fitted permanently with a Bell and Howell 20mm f/1.9 lens in focusing mount. Auxiliary wide-angle and telephoto attachments screw directly into the lens barrel.

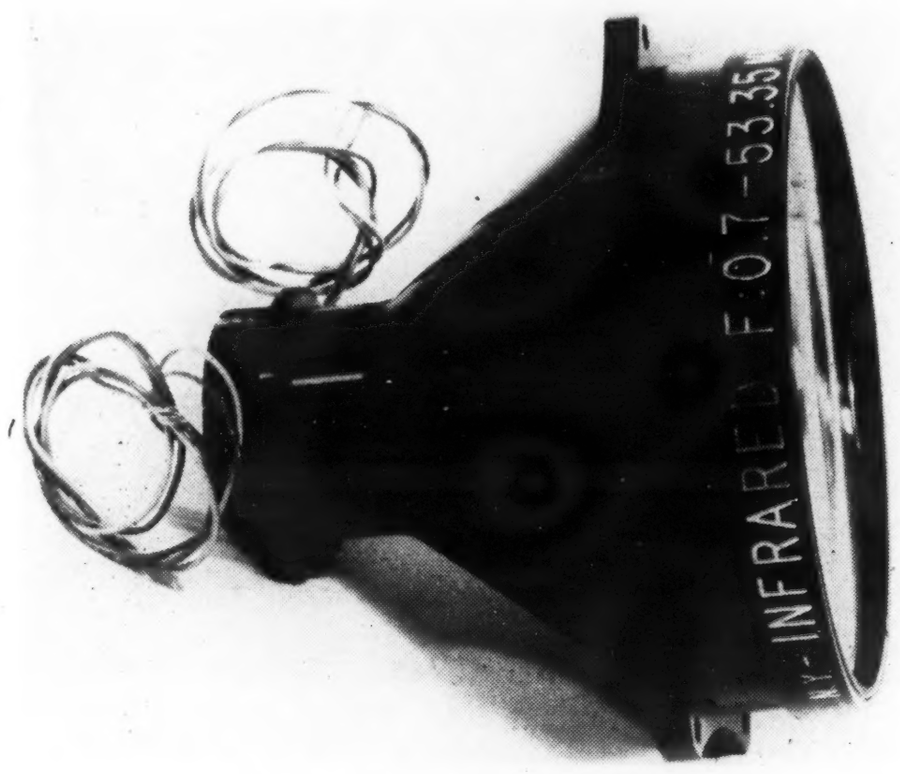
The camera is wound by means of an easy-winding crank which folds back out of the way between windings. The "negator-type" spring affords constant speed throughout the 32-foot run. The camera housing is of die-cast aluminum. List price of the camera is $329.95.

(2) Eastman Kodak Co., Rochester, N. Y., has announced that the light output of the new Eastman 16mm Projector, Model 25B, has been increased 20 percent, and that it may be adapted for magnetic as well as optical sound.

The new Model 25B, says the company, provides so much greater shutter-light transmission than the previous model that it now makes professional theater-quality brightness possible on screens 25 to 35 feet wide.

Included as standard equipment on the Model 25B is the newly-developed Eastman optical-magnetic pre-amplifier which will accommodate the signal output of a magnetic sound head as well as the standard optical system.

The Model 25B is available with either tungsten or arc illumination. With the tungsten model minimum illumination is 550. The arc model has minimum illumination of 3000 lumens for color film (without heat glass) and 2,400 lumens for black-and-white film (with heat glass).



Zoomar Optical Instrumentation

High Speed Optics for Satellite Observation

For those interested in the optical instrumentation of of the IGY satellite, Zoomar, Inc., Glen Cove, N. Y., has released some information concerning the optics developed by them that will be used in the satellite.

The optics consist of a pair of high-speed lenses mounted opposite each other, which will alternate in facing the earth's surface as the satellite rotates. The lenses consist of a plastic Fresnel type front element and small glass rear element. They have a speed of f/0.7 and a diameter of 3 inches and weigh 2½ ounces each, including the housing. They will pick up infrared radiation reflected from clouds and will be focused on a very small detector unit. Solar batteries inside the Zoomar unit will activate each unit as it faces the earth's surface, and will turn off the equipment when the satellite is on the dark side of the earth. The information collected by the devices will be telemetered back to the earth.

Praktina FX Camera Radio Control Unit

Radio Controlled Camera

A radio control unit, which permits operation of the Praktina FX Camera automatically at distances up to one mile and more from the camera itself, without external wiring, is announced by Standard Camera Corporation, 319 5th Ave., New York 16, N. Y.

The unit provides for the first time in any commercially available 35mm camera, a method of remote control operation which will prove invaluable to nature, scientific, industrial, professional and amateur photographers.

Known as the Praktina FX Radio Control Unit, it works in conjunction with the Praktina FX camera and the Praktina FX motor. Up to 420 exposures are possible, using the accessory Praktina FX 50-foot capacity bulk film magazine, or either 20 or 36 consecutive exposures with standard film rolls.

In operation, the receiver component of the FX Radio Control Unit is plugged into the electric motor attached to the FX camera. The transmitter component may then be used at any distance up to a mile or more from the camera to close a relay circuit which activates the electric motor to operate the camera. A sequence of operations takes place in which the shutter is released to take the picture, the film is transported to the next frame, and the shutter wound for the next exposure. The Praktina FX Radio Control Unit may be set up to operate as many cameras as the photographer wishes from the same transmitter.

In areas where human operation of the camera is excluded because of dangerous conditions such as excessive temperature, deadly fumes or radiation, the camera could be set up and triggered remotely.

The manufacturer states that the equipment will have many uses in the field of intelligence and surveillance and also in military photography since it can be operated and controlled from a safe distance unknown to the persons being photographed.

The price of the Praktina FX Radio Control Unit. including shortwave transmitter and receiver (less batteries) will be about $100.00.

(*Continued on page* 58)

FACSIMILE

COMMUNICATIONS FOR COMMERCE

During the past 8 years American Airlines pilots have relied on Facsimile for complete up-to-the-minute nationwide information . . .

Dependability is the chief factor in governing all phases of commercial flight activity. Experience on many billions of miles of safe, courteous flight has gained for American Airlines the confidence of the public. Times Facsimile weather transmission equipment has earned similar respect from American Airlines for its accurate and dependable recording of weather information.

TIMES FACSIMILE CORPORATION

540 West 58th Street, New York 19, N. Y.—1523 L Street N.W., Washington 5, D. C.

SENATOR SALTONSTALL ON SMALL BUSINESS

(*Continued from page* 23)

climate they can, with their own know-how, compete in many instances with much larger concerns and contribute significantly to our defense efforts. It is also most important that every man having a procurement function understand the impact on our economy of contract awards amounting to billions of dollars a year.

Task Before Us

When we think of small business in terms of a future emergency in which our entire industrial potential must be mobilized, it can be seen that the task before us is twofold. Obviously, the first phase of our problem is to do everything we possibly can now to help maintain an economic climate in which small businesses prosper and stay strong. This is essential for the reason that when the time becomes necessary for the Government to call upon the facilities of small manufacturers, either as prime or subcontractors, those facilities should be as vigorous as a profitable peacetime economy can make them.

The second phase of our task should be to take advantage of the present to prepare small producers to assume their responsibilities in the event they are needed, as they have been in the past, for some future emergency. In brief, the present should be utilized as a period of training for small business in the theory and practice of becoming suppliers to the military establishment.

Here again, the best teacher is experience. Smaller businessmen, therefore, can become much better sources of supply for the Government during a future emergency if they can learn how to do so before the emergency develops.

It is abundantly clear that in order for small business to fully share in defense procurement, a great responsibility rests upon the contracting officers and procurement policy officials of the Department of Defense.

Defense Department Responsibilities

The Defense official must take more than a localized interest in the welfare and prosperity of small business. I have described some of the difficulties which small business has in sharing opportunities with larger companies for defense procurement. Now, perhaps with some repetition, there are several points which should be considered by defense officials in respect to small business procurement.

• First, in the all-important matter of attitude, it is essential that those responsible for spending the procurement funds which Congress appropriates have confidence in the ability of small business. It is only natural for a contracting officer, who is responsible for the success of a particular development of a production project, to look to the most experienced large producer. It is necessary to take what may be termed a calculated risk at times in selecting a smaller business when it is capable, so as to better establish its capabilities for defense work. The need for a wide mobilization base in time of national emergency dictates that contracting officers and procurement officials exercise great care and judgment in awarding, wherever possible, contracts to small companies, even though we may have a greater degree of confidence in the larger and tested ones. I cited one example of that just previously. Every effort should be made to cooperate with the Small Business Administration in its effort to provide new sources of supply.

• Second, contracting officials for the Department of Defense must bear in mind the inherent limitations of small business to cope with the administrative complexity of Government contracting. We can greatly assist the role of small business in our defense picture if we keep to the simplest form and amount of administrative and paper work demanded of our suppliers.

• Third, Defense officials should become thoroughly familiar with and utilize to the maximum extent possible the established small business set-aside procedures. These are designed not only for the benefit of small business, but for the benefit of our entire defense establishment. That set-aside procedure, I think, is beginning to be better understood.

• Fourth, every attention should be given to the possibility of rendering financial assistance through established contracting procedures to small businesses who compete for Government work.

• Fifth, delivery schedules should be as realistic as possible, with particular care in peacetime to the limitations of small business to adapt to emergency programs. This should be watched with the utmost care.

• Sixth, advertised procurement is, of course, the most desirable method, except when circumstances will not permit it. Great care should be given to the maximum use of advertised procurement. When negotiated procedures are deemed necessary, contracting officers should insure as much participation as possible by small business.

• Seventh, when amendments and changes are made to a contract which is being handled by a small business, every effort should be made to administer these changes with the greatest dispatch, inasmuch as the company may not be able to sustain the financial burden involved for

(*Continued on page* 60)

PHOTOPROGRESS

(*Continued from page* 56)

Binoculars With Photographic Camera

From Europe comes word of a unique combination—this time a camera with binoculars. Known as the Cam Binox, the camera-binoculars is a product of the Optical Works J. D. Möller of Wedel, Holstein, Western Germany. The design of this combination is different since Cam Binox does not use the binocular lenses for the camera, but instead, it is equipped with a special 90mm focal length lens, which is interchangeable with a lens of 135mm focal length or one of 50mm focal length. The camera, a high grade precison instrument, is built-in between the binocular barrels. Though it is small, the camera has features such as "X" and "M" contacts for synchronized flash and a metal focal plane shutter with "B" and speeds of 1/30, 1/50, 1/100, 1/200, 1/400 and 1/800 second. Shutter and film wind are interlocked. The camera is loaded with double cassettes for 20 exposure 16mm film, unperforated. Format is 10 x 14mm. The binoculars fulfill the functions of a viewfinder as well as that of rangefinder. The 7 x 35 prism binocular is a high quality instrument which differs from similar instruments only in that it has a built-in camera.

portant contributions to commercial and military television include
:h RCA firsts as the Iconoscope, Image Orthicon, Color Image Orthicon
d Vidicon. Development work on camera tubes never stops at RCA.
cent RCA advances are the new low-light-level Image Orthicon—
ecially useful for *"night"* television, and the new developmental
inch Vidicon—useful in compact, lightweight, military cameras.

nether you are working on surveillance equipment, missile guidance,
traffic control, telemetering, or any other military project where
evision can perform a vital service—call on RCA for the camera tubes
u need. World's largest manufacturer of camera tubes today, RCA
"headquarters" for the most comprehensive line in television.

r more information on RCA camera tubes for military television, call
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224 N. Wilkinson Street, Dayton, Ohio, HEmlock 5585.
1625 "K" Street, N. W., Washington, D. C., DIstrict 7-1260.

RADIO CORPORATION OF AMERICA
Electron Tube Division • Harrison, N. J.

RCA-5820—Image Orthicon for Black-and-White TV

RCA-6474—Image Orthicon for Color TV

RCA-6198, **RCA-6198-A**} Vidicons for Industrial TV

RCA-6326, **RCA-6326-A**} Vidicons for Broadcast TV

RCA-6849—Low-light-level Image Orthicon

Dev. No. C-73456—½-inch Vidicon for Portable TV Cameras

RCA Progress Report on TV Camera Tube "FIRSTS"

1939 RCA announced commercial availability of the Iconoscope—the camera tube that made electronic television possible.

1940 RCA announced the Amateur Iconoscope—opened the television field for experimenters.

1942 RCA introduced the first small Iconoscope—for aerial weapon guidance.

1944 RCA provided the military services with the first Image Orthicon—a supersensitive camera tube.

1946 RCA introduced the first Image Orthicon (the camera tube that revolutionized TV camera techniques)—for studio and outdoor pickup.

1952 RCA produced the first Color Image Orthicon—for use in compatible color television cameras.

1952 RCA announced the first commercial Vidicon—for industrial TV.

1955 RCA announced a developmental ½-inch Vidicon—for miniature portable TV cameras.

1956 RCA designed and built a low-light-level Image Orthicon—a new camera tube especially useful for *"night"* military operations.

a protracted period.

Let me give you one instance of that with which I personally came in contact. We had a small shoe company in Massachusetts making Army shoes. The methods of procurement were changed. The company went on and from time to time its financial credit with the bank ran out. What happened? Because there was delay through the Army moving from one headquarters to another, the paperwork got delayed and that company went into bankruptcy and had to be liquidated.

We put in a claim for Congress to pay for that damage. The military admitted that they had delayed from six months to nine months. This was during the war, and that company, a reputable small company of long life in Massachusetts, was completely put out of business because most of its business was with the Government, all of it at that time; the Government delayed its payment, and it had to be liquidated. We put a claim through Congress, and I think we finally got them some $86,000 of Government funds. But that man had to get a new job. It was a family business and it was completely put out of business because of Government delays which could have been avoided.

Finally, procurement officials can help tremendously by educating all of their personnel as to the importance and need for developing the potential of small business and supporting them where they take the responsibility.

Much progress has been made during the past decade, through legislation and through administrative programs, in our efforts to develop a sound and strong small business segment in our economy. Much still needs to be done.

Responsibility of Congress

Many acts of Congress have provided the legislative authority for financial assistance programs, procurement programs, and even agencies specifically designed to be of assistance to small business.

To devote special attention to the maintenance of small business and our free enterprise system, Congress has created the Senate Select Committee on Small Business as a permanent committee.

Congress has expressed its concern for the survival and welfare of small business by incorporating small business provisions in every basic procurement statute enacted since the end of World War II. These provisions clearly establish a policy with respect to the utilization of small business facilities in defense and civilian production. The Armed Services Procurement Act of 1947, the Selective Act of 1948, the Federal Property and Administrative Services Act of 1949, the Defense Production Act of 1950 and others have all provided that small business must receive a fair share of Government contracts. Congress has not legislated, nor does it seem advisable to do so, what is to be considered a fair share of Government contracts. The percentage of military net procurement going to small firms has fluctuated annually between 32 and 16 percent since the end of World War II. It is clear that Congress does believe that every effort must be made to open up and to increase the small business share in every type of procurement.

Three times, Congress has established an agency to deal specifically with the problems of small business. During World War II, the Smaller War Plants Corporation assisted small firms to secure Government contracts and financial assistance. In 1952, in an amendment to the Defense Production Act, the Small Defense Administration was established to assist small firms during the Korean emergency. Believing that financial, procurement, technical and managerial assistance was necessary in peacetime as well as during emergencies, Congress established the Small Business Administration in 1953.

Defense Department's Responsibilities

Through various directives, the Defense Department has broadened its cooperative relationship with the Small Business Administration and it has instituted the beginnings of a small defense subcontracting program.

In many instances, the use of emergency procurement and short delivery schedules has been corrected. Wider dissemination of procurement information has been accomplished. I believe that throughout all the military procurement agencies there is now a greater realization of the need for consideration of the problems of small business.

Small Business Administration

May I devote a few words to a discussion of the operations of the Small Business Administration, for it is this agency which is the culmination of congressional attempts to render all types of assistance to small business.

Primarily, the SBA was designed by Congress to be the spokesman for small business among the executive agencies. Small business concerns cannot afford to have representatives either in Washington or at procurement centers throughout the country. It is for this reason that Congress designed the SBA as an independent agency, not affiliated with or within any other department or agency. I believe that past experience dictates the need for such independence.

I personally had quite a discussion on that subject with my friend and classmate at Harvard, Sinclair Weeks, Secretary of Commerce, who strongly believes that the Small Business Administration should be within the Department of Commerce. There are a good many arguments for that. But if you put it within and under the Department of Commerce, then it is not independent. It cannot fight for small business as an entity compared with all the other interests that the Secretary of Commerce must consider. I oppose the feelings of Mr. Weeks in that regard, and Congress has felt very strongly about it.

Of primary importance to small business is the SBA financial assistance program. Recognizing that small firms are frequently unable to secure intermediate and long-term credit—and I cited the reasons for that earlier—Congress provided that the SBA may make working capital loans, for the purchase of machinery and equipment, and loans for expansion of plant and facilities, with maturities as long as ten years. Since the taxpayers' money is being used, and since this is not a subsidy program, the SBA legislation stipulates that all loans must be of such sound value and so secured as to reasonably assure repayment. That has been well handled up to the present time.

In three years of operation, the SBA has approved business loans for a total of $235,750,000. In fiscal year 1954, 473 loans were made for $27,739,000; in fiscal 1955, 1,172 loans were made for $55,975,000; in fiscal 1956, 1,915 loans were made for $81,977,000. For the first half of fiscal 1957, 1,600 loans for $70,059,000 have been made. Almost two-thirds of the 5,160 business loans approved have been in participation with local financial institutions. Congress itself desired that the local banks be encouraged to extend at least part of the financial assistance desired by small business, for in such a fashion can lines of credit be established for future purposes.

In addition to making loans, the SBA's financial specialists engage in financial counseling, enabling a firm to rearrange its accounts or to better present its case before a local bank so that a Government loan is not needed.

I have had several instances of that. One was with a wholesale meat man. He wanted to get SBA loans to build up his wholesale meat business. What he needed was consultation rather than a Government loan. I firmly believe that as long as private financial institutions are unable or unwilling to provide adequate credit to sound, (though weak credit-wise) small business, the Congress will insist on the existence of a Government program to fill this credit gap.

The SBA has developed a cooperative program whereby it may assist small firms to secure tax amortization certificates. Agencies in charge of the issuance of such certificates have agreed to allow SBA to secure and present additional information which will more adequately reflect the need for such certificate. As a matter of fact, I personally feel that this agency should be given a more positive role in the issuance of such certificates.

When a small business has been declared by a procurement officer to be ineligible to receive a contract upon which it was the low bidder, the SBA is authorized by law to issue a certificate of competency when it believes this firm to be both financially and technically competent. And that is very important.

Once such a certificate is issued by SBA, the law provides that contracting officers must accept it as conclusive so far as financial and production requirements of the contract are concerned.

So far, contracts have been awarded to 250 small companies for a total of $30,546,000 as the result of this program. These certificates of competency were issued to small producers, all of whom were low bidders or within negotiating range, after a thorough investigation by SBA showed that they were in fact, by reasonable standards, both financially and productively capable of performing the contract in question.

It goes without saying that for the SBA to override the judgment of procurement officers on the competence of a small company places a very heavy responsibility on the certifying agency. SBA meets this responsibility by maintaining a continuing interest during the full life of any such contract. Should the contractor encounter difficulties in meeting production schedules because of technical or other problems, SBA stands by to offer such assistance as may be necessary.

From the point of view of national security, what does this certification procedure mean? As I see it, it means that here are some 250 small companies, most of which were undoubtedly an unknown quantity to military procurement officials, which are now gaining invaluable experience as suppliers to the Army, Navy and Air Force in peacetime.

The Small Business Administration is authorized by law to examine particular procurements to determine which are suitable for performance by small firms. Upon agreement by the contracting officer, all or part of the procurement may be set aside for exclusive bidding by small firms. From August 1953, through September 1956, $1,250,000,000 worth of Government purchases have been set aside for small business as a result of this joint determination procedure. Perhaps this is a major reason why, in the case of the Department of Defense, prime contract awards to small firms have been proportionately greater in the past few years than during the Korean War. In 1954, new military prime contracts to small businesses were $2.9 billion; in 1955, $3.2 billion, and in fiscal 1956, $3.5 billion.

SBA procurement specialists have been most active in assuring small firms adequate information concerning procurements on which they are capable of bidding. Referrals of both prime and subcontract opportunities are made. In addition, the agency assists small firms to get on bidders' lists or qualified products lists.

Finally, the SBA has been most active in providing small firms with the latest information on technical and managerial subjects.

It can be seen that all of these programs have been designed to assist small firms in those areas where they have encountered difficulties.

President's Committee

As a member of the legislative branch and as a member of the Senate Small Business Committee, I was mightily pleased to see the establishment of a President's Cabinet committee to study the problems of small business. I also believe that the recommendations published in its first progress report, dated 7 August 1956, will be of help in guiding the various agencies concerned. Among other things, the Cabinet committee has recommended that the need for advance and progress payments should not be treated as a handicap in the awarding of a contract. Consideration is also given to the need for adjusting our thinking on renegotiation to the public policy of increased subcontracting. Of particular interest is the recommendation that there be a comprehensive review of procurement policies and procedures.

The President's Cabinet committee's report also contains constructive proposals with regard to tax relief and the continuation of the Small Business Administration. It makes, I think, some sixteen recommendations. Some of the administrative ones have already been carried out. Bills are filed in the Congress for some of the others.

Free Competition for Small Business—Conclusion

I have tried in this article to give emphasis to what I consider to be a few basic aspects of small business, chiefly small manufacturers, in relation to our national security. As you know, New England has a higher density of small independent business than any other section of the country. As suppliers, present and potential, to the Government, they have one quality which many larger companies lack—that is, flexibility. They are easy to work with and can adjust themselves quickly to specification and schedule changes because they are not burdened with a corporate bureaucracy. Those familiar with a production record of small plants during World War II and Korea are not inclined to belittle the contributions made by small companies.

I believe that the role of small business in our economy is best summed up in these words from the Small Business Act of 1953:

> "The essence of the American economic system of private enterprise is free competition. Only through full and free competition can free markets, free entry into business, and opportunities for the expression and growth of personal initiative and individual judgment be assured. The preservation and expansion of such competition is basic, not only to the economic well-being but to the security of this Nation. Such security and well-being cannot be realized unless the actual and potential capacity of small business is encouraged and developed."

That was the preface of the Small Business Act of 1953.

The free enterprise system, from which we derive our strength and upon which depends our national security, has always been anchored and must always remain anchored to the welfare of the millions of small and independent companies which are the bedrock of our industrial democracy.

AFCEA RADIO AMATEURS ON THE AIR

***EDITOR'S NOTE:** The following article by Commander Ray Meyers, AFCEA Regional Vice President for the West Coast Area (Region F), follows up articles in the June issue of SIGNAL, page 21 and the August issue, page 42. If you are a radio ham, send your call letters to AFCEA National Headquarters, 1624 Eye Street, N.W., Washington 6, D. C., or talk directly with Ray. Let's build up the "Ham List" to a size where the "AFCEA Ham Net" will attract national and international attention. At National Headquarters, we are indebted to Ray for his drive and enthusiasm.*

In response to previous notices which were carried in SIGNAL shortly after our last national convention, we have a large number of AFCEA members holding FCC amateur licenses who would like to make radio contacts with others of our organization.

Once we are on the road, and our AFCEA net is well established, it may be possible for us to have a station at our next convention. It would be available for our members to make contacts with others all over the world. Also, it will enable members to contact the folks at home and chapter members not able to make the trip. In the future, it will provide National Headquarters a means to contact chapters expeditiously on subjects of importance.

Our original notice requested all interested hams to give an opinion as to spot frequencies and times of operation in order that we could establish meeting times most convenient for the majority. So spread out is the AFCEA membership, that there is not sufficient data on hand at present to pin down specific frequencies, or scheduled hours of operation.

In order to get the ball rolling, based on recommendations of some of the group, we are setting up a temporary week-end schedule until more data on SKIP and reliable times of operation are determined. As some of our members are overseas, this week-end schedule will find them operating a portion of Monday due to date-line and time differences.

Here is our tentative plan. It may be noted that the frequencies we have chosen are but five kilocycles lower than the ARRL National Calling and Emergency frequencies. This is deliberate and insures that we do not accidentally QRM some local emergency in progress. A good operating plan would be for the AFCEA net members to monitor the ARRL calling frequency for four or five minutes before going on the air. This would alert you to any emergency in progress and in turn, you could alert the AFCEA net members who may be in a position to help.

Our first week-end schedule will start the week end after you read this article in SIGNAL. It may take several weeks to get going full blast for our members are scattered throughout the world.

A recommended calling procedure and sign-off on each transmission on the net frequencies (in order that members hearing our calls will recognize us and break in) would be:

CQ AFCEA de W6MLZ AR
W6MLZ and AFCEA de K2FV K
W6MLZ K2FV and AFCEA BK—
de W4KN

A few words of caution—don't let anyone talk you into discussing classified material. A lot of brother amateurs may want to know what AFCEA means. That's the time to outline our primary objective which is contained in each issue of SIGNAL just above the application for an individual membership (page 80).

One thing for sure—you won't be able to tell from the handle our AFCEA amateurs give you whether you are working a General, Colonel, Major or Private first; an Admiral, Commodore, Captain or Seaman 3rd; a former U.S. President, Secretary of State or Civil Service worker; a President, V-P, Chief Engineer, or Technician of some large electronics firm—the amateur is a humble person ready to help his community in time of emergency, or to exchange ideas on new techniques and how to make them work.

Here are a few calls you may run across on the ham bands—all are AFCEA members:

W1BUD and 9 other group members in ARRL Headquarters.
K2's ASQ and FV
W2's BR, GVU, LUO, NUI and VZG
W3's QR and VHV
W4's AAY, IH, KN, LW and WVS
K6's AB, FH, HV and LDF—
W6's AJU, AOI, CZC, GNO, KW, MLZ, OON, ORS, STD, TMY, UJI, UJL, and YY
W7's GYJ and KOL
W8's MGQ and QBF
W9's AC, DW and JJJ
WØ's DEL

As soon as we learn of all of our members holding amateur calls we hope to permit some well-known producer of amateur radio equipment to print a directory—complete with titles, handle and QTH. In sending in your calls for the directory, list your handle, chapter and other pertinent data.

Let's hear from you and get the ball rolling. 73—W6MLZ.

Ed's note—QST and CQ reprint if desired.

28095	KCS	A1	emission	at	1800	GMT,	1300	EST	or	1000 PST
*29635	"	A3	"		1900	"	1400	"		1100 "
21045	"	A1	"		2000	"	1500	"		NOON "
*21395	"	A3	"		2100	"	1600	"		1300 "
14045	"	A1	"		2200	"	1700	"		1400 "
*14220	"	A3	"		2300	"	1800	"		1500 "
7095	"	A1	"		2400	"	1900	"		1600 "
* 7245	"	A3	"		0100	"	2000	"		1700 "
3535	"	A1	"		0200	"	2100	"		1800 "
* 3870	"	A3	"		0300	"	2200	"		1900 "

VHF—145.345, and 50.545 MCS AT 2000 Local time.

*Note—SSB Group meet 30 minutes later 15 KCS from the top edge of the band.

E. H. Rietzke, President CREI

CREI's Contribution to National Technological Education and Security

IN THESE DAYS of guided missiles, long range ballistic missiles, earth satellites, atomic and hydrogen weapons, atomic propulsion, long range radar, and many other wonders, every technological education program must be used to maximum advantage. In order to see just what our contribution is, and how that contribution could be strengthened, we took inventory. Statistics can be dry—but they can also be significant. (The following statistics apply to the CREI home study—correspondence—division only.)

During the year ending October 31, 1957:

1. CREI GRADED 96,789 TECHNICAL EXAMINATIONS. This represented careful attention by instructors to 967,890 searching questions and engineering problems. 187,371 lesson texts were mailed to students. CREI students devoted approximately 1,452,000 hours to technical study. 5,642 new home study students were enrolled during this one-year period.

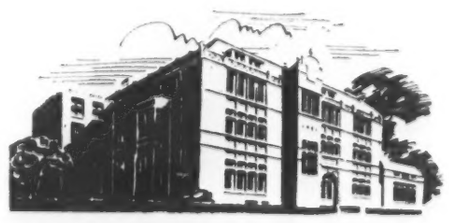
2. WHAT DID THEY STUDY? *Applied* mathematics from Algebra and Logarithms through Integral Calculus; *Applied* theory from Ohm's Law through Transistors, Microwaves, Forward Scatter, Computers, Servomechanisms, Radar, Electronic Navigational Devices—the entire field of modern electronics. They studied from 7,741 pages of strictly up-to-date technical assignments. CREI courses are continually under revision by our own engineering writing department. 84% of the present CREI material carries copyright of less than 5 years.

3. WHO ARE THESE CREI STUDENTS? They are mature young men (average age 27) who were professionally employed in some phase of electronics at the time of enrollment. About one-third are military, the rest in civilian electronics. In the Navy, for example, they range from Seaman Electronic Technician to Captain. In civilian life they range in education from high school graduate to Master Degree in Engineering and Science—from a few months to many years of experience in electronics.

4. WHERE ARE CREI STUDENTS? They will be found wherever electronics is important. 122 may be found above the Arctic Circle on our first line of defense, the DEW-Line. Hundreds of CREI students and graduates monitored the recent 5,000 mile flight of the Snark on the missile range from Cape Canaveral to Ascension Island. When you ride one of the airplanes of the great all-radar equipped fleet of United Air Lines, your feeling of safety will be enhanced if you remember that for more than 10 years, hundreds of United Air Lines' electronics maintenance men have been and are studying with CREI. If you are a world traveler and happen to fly the Burmese Airline, you will have this same increased safety factor. CREI students are working on the design of atomic and hydrogen bombs and are in the electronic and missile divisions of the aircraft companies that make the vehicles that will carry the bombs. They are at Alamagordo and China Lake and Edwards Air Force Base—and at SAC Bases around the world. They will be found by the hundreds among the field engineers of our major electronic manufacturers. And they are in your local radio and TV broadcasting stations.

On a student-hour basis, the study record of the CREI home study division is the equivalent of a residence technological school with a full time enrollment of 1200 students. The CREI home study program is accredited by Engineers' Council for Professional Development on the same basis as our residence technical institute program—as the equivalent of 112 weeks of full time study, practical work on the job being accepted in lieu of laboratory work in the school.

WE AT CREI feel a tremendous sense of responsibility in our obligation to *beat our best* in our contribution to national technological education and national security.



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Chapter News

Boston—Robert Porter, in charge of operational analyses for the Missile Systems Division of Raytheon Manufacturing Company, points out Army Hawk missile. Looking on, left to right, are: Frank Lyman of Cambridge Thermionics Corp.; Ray Meader of New England Telephone and Telegraph; Capt. W. B. Goulett, USN (Ret.), executive vice president of AFCEA, and Col. M. D. Harris, president of the Boston Chapter.

Augusta-Fort Gordon

The chapter's annual elections were held at its November meeting with the following results:

Honorary presidents—E. H. Gibson, Southern Bell Telephone and Telegraph Company; Col. David P. Gibbs, Col. B. E. Small and Col. Otto T. Saar of the United States Army Signal Training Command; J. C. Woodward, Southern Bell.

President — James M. Williams, Southern Bell; vice presidents—M/Sgt. Martin L. Jenkins, TSESS; George W. Sims, Southern Bell; Col. Erling J. Ross, USASTC; secretary—Jack R. Young, Southern Bell; treasurer—Lt. Col. Darce R. Knight, USASTC.

Board of Directors — William H. Woody, Orian S. Niehuss and George H. Bragg, all of Southern Bell; SFC. Clarence H. Smith, Hq. Det., Fort Gordon; Maj. Otto Lechman, Radio Corporation of America; Capt. Luther B. Smith, TSESS; M/Sgt. Martin Bell.

National Councilmen—E. H. Gibson and Col. Clarence Dunlap, TSESS.

Boston

Chapter members were treated to analytical explanation of the Nation's missile program by Robert Porter, in charge of operational analyses for the Missile Systems Division of Raytheon Manufacturing Company, at a dinner-meeting on November 14th.

During his presentation, Mr. Porter declared the three major problems in missile development were speed, range and reliability. He described a missile as "a flying machine wrapped around a war-head."

On display at the meeting, held at the Charlestown Naval Shipyard, were the Army Hawk missile, for which Raytheon is prime contractor, and the Sparrow III missile, developed by Raytheon for use by Navy fighter aircraft in the Fleet Air Defense.

During the business session, chapter members heard AFCEA's new Executive Vice President. Capt. Wilfred B. Goulett, USN (Ret.), report on national association affairs and outline plans for further growth of membership and activity.

Chicago

Chapter President Henry J. McDonald participated in the Chicago Tribune Outstanding Achievement Award Ceremony held at Nathan Hale Court, Tribune Tower, Chicago, on October 19th. Hugh Milton, Assistant Secretary of the Army for Manpower and Reserves, awarded the Tribune's gold medals "in recognition of outstanding performance of duty as a member of a unit of the reserve components of the Army of the United States." John H. Thompson, Military Editor, represented the Tribune in these presentations.

One representative from each of the following technical service organizations—Society of American Military Engineers, Armed Forces Chemical Association, National Defense Transportation Association, American Ordnance Association, Quartermaster Association, and the Armed Forces Communications and Electronics Association — made awards to enlisted reserve personnel from Illinois who had distinguished themselves in the corresponding technical services of the Army.

Chicago— Henry J. McDonald is pictured with AFCEA Chicago Tribune Awardees, left to right: Sgt. William R. Kramer, Sgt. Robert C. Merrill and M/Sgt. Gene R. Gauwitz. Another award winner M/Sgt. Charles E. Fowler looks on.

Ft. Monmouth—A large number of industrial representatives attended the November meeting. Shown, left to right, are: Bob Boden, Philco Corporation; Arthur Adamson, Electronics Associates; Charles Arthur, Westinghouse Electric; Robert A. Bassell, Radio Corporation of America, and Frank J. McCormack and Jack Phillips, Electronics Associates.

Mr. McDonald, representing the Chicago Chapter of AFCEA, awarded one-year memberships and AFCEA Certificates for outstanding performance of duty and accomplishments in the field of communications and signal activities to: Sgt. William R. Kramer, 33rd Signal Company; Sgt. Robert C. Merrill, 805th Signal Company (Depot); M/Sgt. Gene R. Gauwitz, Hq. 85th Signal Company.

Dayton-Wright

Guest speaker of the chapter's November 21st meeting was Brig. Gen. Clyde H. Mitchell, USAF, Commander, Rome Air Force Depot. General Mitchell addressed a gathering of some 160 members and their guests at the Wright Patterson Air Force Base Officers Club. The subject discussed was "The Care and Feeding of Electronics."

The General detailed the phenomenal growth of maintenance and support operations now required to support the multi-billion dollar Air Force electronics inventory. Certainly a highlight was General Mitchell's advanced discussion and review of "electromagnetic radiation effects on man." This exhaustive and revealing study has been conducted at Rome Air Force Depot and current news reports notwithstanding. The Air Force unequivocally denies that any physical harm has been effected by radar radiation regardless of power output.

Detroit

A comprehensive tour of the facilities of the local Office of Civil Defense featured the chapter's first meeting of 1957-58 year, held on October 30th.

Program arrangements were made by Paul J. Schafer, a former president of the chapter. The members and guests met for a social hour and dinner prior to the meeting.

Fort Monmouth

The first dinner-dance of the season for the Fort Monmouth Chapter drew a large attendance November 21st in the Sapphire Room at Gibbs Hall Officers Club. Mario De Pasquale's orchestra played for dancing.

A post-wide campaign is in progress for new members for the chapter which ranks third in size among AFCEA chapters throughout the world. Colonel Robert Haffa, Director of Evans Signal Laboratory, is membership chairman.

Other committee chairmen are: W. J. Laverick, meetings; Dr. Robert Meijer, industrial relations; Lt. Col. John E. Jenista, reserve affairs; J. Peter Hoffman, public relations; George Trad, finances; Thomas Schlitz, reception, and Arthur Adamson, development of scientific man power pool.

Keflavik

At its meeting of July 10th, the following officers were chosen for the forthcoming six-month period:

President—1st Lt. Edward D. Aitken, USAF; vice presidents—Capt. Robert A. Wooton, USAF, and John Hamilton, Bendix Radio; secretary— Maj. Benjamin A. Roberts, USAF; treasurer—Alfred J. Markus, Bendix Radio.

The chapter holds monthly dinner meetings at the 932nd AC&W Squadron which is some seven miles from Keflavik Airport. Subjects of recent meetings have included "Tropospheric Scatter in Iceland," "Iceland Communications and Electronics Operation and Advancement" and "Dew Line."

Feature of the November meeting was a tour of the tropospheric plant at the AC&W Squadron, which was conducted by Ralph Bradburn, RCA field engineer at the plant.

Lexington

The chapter enjoyed a tour of the Sylvania Electric Products, Inc., plant at Winchester, Kentucky, on November 25th. The plant manager, Mr. Donald J. McNeil, and his staff went all out to provide the chapter with a very pleasant and informative evening. Following an excellent meal in the plant cafeteria, the members were given a guided tour of the plant.

The mass production and processing of photographic flash bulbs and projector lamps was explained to the members. This was the first plant tour for the chapter and it was enthusiastically received by all.

The imminent transfer of Lt. Col. Randolph Vinding, chapter president, was announced. Charles Morrison of the General Telephone Company, who had been serving as executive vice president of the chapter, was chosen to succeed Colonel Vinding.

London

Chapter members and guests heard about the early days of engineering during a dinner meeting at the Columbia Club Hotel on November 18th. Guest speaker was Mr. A. E. Bowyer-Lowe, A.M.I., Mech.E.,M.J., Inst. E., F.B.H.I., who spoke on "Reminiscings and Ramblings of an Engineer."

Mr. Bowyer-Lowe, was well qualified to speak on the early days of engineering and his experiences included many firsts in the electrical, radio and mechanical engineering fields. He is a chairman of the Radio Manufacturers Association and currently a member of the Radio Industries Club.

He was awarded the first Marconi License to manufacture entertainment radio sets in the United Kingdom; he designed and built the first mechanical record changer and his many radio and electrical inventions have received numerous gold medal awards from the British Government. He designed and built the Phoenix Motor Car in 1908, and related some of the difficulties encountered and the innovations required to solve the engineering problems of those days.

Louisiana

Dr. Joseph C. Morris, head of the physics department at Tulane University and chapter vice president, presented his views on the Russian satel-

North Carolina—Some of those attending the November meeting at Ft. Bragg, are seen, left to right: Brig. Gen. C. H. Chase, C/S XVIII Abn. Corps and Ft. Bragg; D. J. Lawson, Southern Bell Tel. & Tel. Co., Charlotte; W. E. Forshand, AT&T Co., Charlotte; J. R. Fowler, chapter vice president, Carolina Tel. & Tel. Co., Tarboro; E. A. Duquet, Bendix Radio Div., Baltimore, and Col. H. J. Hort, 1st Log. Comm., acting chapter secretary, Ft. Bragg.

lite "Sputnik" at the chapter's November 6th gathering.

Held at the Naval Air Station commissioned officers mess, the meeting was preceded by a fellowship hour and dinner.

New York

The November 20th meeting held at the Belmont Plaza Hotel, New York City, featured a talk on the radio signals from Sputnik I and Sputnik II by Lt. Col. Madison P. Rehm, of RCA Communications, Inc.

Col. Rehm described the methods used to "listen-in" on both Sputniks and also discussed the radio propagation effects. Sputnik signals were the first to be received from outer space (at least from earth-manufactured radio transmitters) and the recorded data will give invaluable information to scientists with respect to radio propagation theories.

Edwin C. Carlson, chapter vice president, presided in place of the chapter president, Benjamin H. Oliver, Jr., who was away on a business trip. The report of the nominations committee was submitted and the annual elections will be held at the December meeting.

The meeting was preceded by a social hour and dinner. Total attendance was 160.

North Carolina

"Earth Satellite for Geophysical Studies," a program sponsored as a joint venture of the Bendix Radio Division of Bendix Aviation Corporation and the Naval Research Laboratory, was the feature of the chapter's meeting on November 8th. Guest speaker was Ernest A. Duquet from Bendix, Baltimore, Md.

Mr. Duquet, who has been responsible for the production, by Bendix, of the ground receiving components of the radio tracking system known as Minitrack, delivered a timely lecture-demonstration. His presentation included specially prepared slides and a description of the satellite in flight, from launching to self-destruction. The "space-borne" transmitting components of Minitrack have been developed and produced by the Naval Research Laboratory.

The dinner-meeting took place in the main ballroom of the Fort Bragg Officers Open Mess and drew an attendance well over one hundred members and guests. Program arrangements were made by Col. Henry J. Hort, Signal Officer, 1st Logistical Command, Fort Bragg, who is acting secretary of the chapter and who was at one time president of AFCEA's Augusta-Fort Gordon Chapter.

Paris

The chapter had its first dinner meeting of the season on October 25th at the Cercle Militaire, Place St. Augustine. Sixty-five members and their guests attended.

Brigadier General Frank W. Moorman, chapter president, introduced Major General P. E. M. Combaux, Director of the Service des Télécommunications at the Direction des Etudes et Fabrications d'Armament (D.E.F.A.), who gave an address entitled "Some Thoughts on Electronics and War."

Philadelphia—Chapter president J. Burton Henry addresses the group at the November 7th meeting.

Philadelphia

Over 150 members and guests attended the November 7th chapter meeting held at the U. S. Army Supply Agency. Host for the evening, Colonel E. L. Littell, Commanding Officer of the Agency, paid tribute to the 97th anniversary of the U. S. Army Signal Corps. Albert J. Meyer, first Chief Signal Officer (under the guise of Lt. Colonel Deane A. Dunloy, Chief, Awards Division), came back from "up there" to compare some of the many signal systems he developed in the 1800's with present-day communications.

Chapter President J. Burton Henry of International Resistance Company, introduced guest speaker John N. Dyer, vice president of the Airborne Instruments Laboratories who discussed "Electronics in the U.S.S.R."

Mr. Dyer was one of four American engineering executives invited to visit Russia and inspect plants and laboratories in the Moscow and Leningrad areas. He found the progress in these plants somewhat startling. At the TV Institute in Leningrad, 3000 employees were working on the development and production of units very comparable to those in the United States. Russia has 25 to 26 cities equipped with TV; however, there is only one network system from Moscow to Toledo. At the Institute of Physics in Moscow, Mr. Dyer was impressed with a basic research program on the measurement of frequency. He pointed out that the average Russian scientist is able to read English (our "Popular Science" was seen everywhere throughout the Institute) which affords them an excellent advantage over the American scientist. Mr. Dyer encourages and urges American students to study Russian to enable us to use Russian technology as they are presently able to use ours.

Mr. Dyer's group also visited a tube factory where 200,000 pulse and high-power tubes are being produced monthly. Here, manually-fed rotary sealing tables were still in use, and very little automation had been installed. At a transistor plant, where low frequency

audio transistors were in production, Mr. Dyer found the germanium cutting advanced, but the assembly poor with little attention given to humidity problems.

Pittsburgh

During a tour of the Duquesne Brewing Company plant on November 21st, chapter members and guests learned that the old-time Braumeister never turned out 864,000 bottles of beer a day, nor did he achieve the clarity and fine flavor that electronic control adds to fine beer.

The group saw how electronics affected the whole process, from the grain airveyors, through the cereal cookers, mash pumpers, lauter tubs, wort checkers, hops brewers, fermentation and, finally, the bottling and casement.

Rocky Mountain

The opening meeting of the fall season was held September 27th in the Stonewall Room of the Ent Air Force Base Officers Club. Officers for the current season were elected, as follows:

President—Col. O. W. Miller, USAF; vice president in charge of programs—Lt. Col. K. N. Keyte, USAF; vice president in charge of publicity and finance—D. E. Barg, General Electric Company; vice president in charge of membership—R. Stephans, Western Union; secretary—Major B. C. DeLosier, USAF; treasurer—1st Lt. F. E. Jones, USAF.

Directors—Lt. Col. S. T. Jacks, USAF; Lt. Col. V. Fedorovich, USAF; M. F. Sanders, Civ., USAF; J. M. McMenomey, Philco Corporation; Capt. F. D. Tappin, USAF, and Capt. B. L. Shelton, USAF.

The October 15th meeting took place at the Fort Carson Officers Club and featured the Bell System color film, "The Strange Case of the Cosmic Ray." The film was presented by John Sheppard of the Mountain States Telephone and Telegraph Company.

Lt. Col. G. G. Kinzler, USA (Ret.), of Deits Brothers Camera Shop, Colorado Springs, gave his popular Hi-Fi presentation at the November 21st meeting. The program included demonstrations of various techniques and capabilities of stereophonic sound.

Rome-Utica

The *Rome Sentinel* reported the chapter's November 20th meeting as follows:

"'Systems vs. Black-Box Procurement' was the topic before last night's meeting of the Rome-Utica Chapter, Armed Forces Communication and Electronics Association, in the Griffiss AFB Officers Club.

"Brig. Gen. Clyde H. Mitchell, Commander of the Rome Air Force Depot, outlined the concepts, philosophy, objects and methods of systems, and 'black-box' procurement whereby big and little business organizations of private industry have a definite part in Government procurement.

"Gen. Mitchell's topic was further illustrated by talks given by procurement officials from both Government and industry.

"Frank E. Greene, Manager of Marketing Negotiations for the Radio Corporation of American, presented a talk on 'Effects on Industry by the System and Black-Box Procurement Methods' and Lt. Col. Herbert E. Greuter, Director of Procurement and Production at RAFD, on 'Application of Systems for Black-Box Procurement.'

"The talks were followed by a round table discussion with members from a large and small corporation and a company-size organization in the electronics field. Joseph M. Roberts, RAFD, served as moderator for such subjects as 'Factors for Application,' 'Congressional Intent' and 'Effects That Procurement Policy Has on Industry.'

"Greene, Sal A. Barone, President of the Northern Radio Company, and Richard M. Osgood, Sylvania Electric Products, Inc., represented the electronics industry.

"Government participants besides Col. Greuter were Rowland A. Clemens, assistant at the Directorate of RAFD Procurement, and Robert V. Decker, Chief of the Contract Division, Rome Air Development Center.

"Program chairman was William L. Roberts, RCA Service Company, who is also vice president of the chapter."

San Francisco—Cyril A. Howler of RCA Laboratories, Princeton, N. J., is demonstrating an electronic heating and refrigeration unit.

San Francisco

The feature of the chapter's November 14th dinner meeting was a lecture-demonstration by Cyril N. Hoyler of RCA Laboratories, Princeton, New Jersey.

Mr. Hoyler demonstrated and talked about some amazing new developments at the laboratory. He covered the field of solid state physics to include a light sensitive solid, a light amplifier and electronic refrigeration. He demonstrated a new reproduction process which uses a zinc oxide coating sensetized by electrons. After exposure to any white light source, it is fixed by 140° heat or by a chemical spray.

The speaker went on to the field of musical synthesis, demonstrating by means of a scope how various frequencies and harmonics combine to form musical tones, and how by means of

San Juan— Inauguration photo of the new chapter president, Wyman S. Borden. The meeting was held at the Fort Brooke Officers Club.

electronics and binary system for combining a few basic frequencies, an amazing new variety of pleasing music can be recorded. He reproduced electronically some very interesting musical selections made by this new process.

The lecture was attended by over 100 members and guests following a social hour and dinner.

Scott-St. Louis

Col. W. E. Groves, Chief of the Development Division, Combat Surveillance Agency, Office of the Chief Signal Officer of the Army, addressed the chapter meeting on November 1st on the subject of "Combat Surveillance, Today and Tomorrow." Col. Groves spoke as a representative of Maj. Gen. James D. O'Connell, Chief Signal Officer, and Brig. Gen. William N. Thames, Commanding Officer, Combat Surveillance Agency.

His discussion was directed principally toward the research and development aspects and the operational applications of this facet of ground combat. Col. Groves pointed out that combet surveillance does not represent a new field of endeavor for the Army—rather, it is a new name for one of the oldest and most difficult facets of ground combat.

Col. Groves defined combat surveillance as "an all-weather, day and night systematic watch over the battle area, to provide timely information for ground combat operations." Continuing, he said, "it includes friendly as well as enemy information obtained from both technical and non-technical means. The need for an integrated combat surveillance system grew out of several fundamental changes in the doctrine of ground maneuver and fire power—all directly related to the advent of mass destruction weapons."

The Colonel went on to say, "The success of this project is, and will continue to be, the result of the cooperative efforts of the Army, Air Force, Navy and related Industry."

Southern California

A record attendance of some 250 members and guests marked the opening meeting of the fall-winter season on November 6th at the Statler Hotel in Los Angeles.

Following the cocktail and dinner period, Chapter President Lester R. Daniels welcomed the large gathering. Joining in the meeting were members of the Los Angeles IRE-PGMIL, including their chairman, Maj. Ernest E. Jernigan, Jr. (on active duty as Chief, USAF's Development Field Office in Hollywood) and Vice-Chairman Mathew E. Brady of Ramo-Wooldridge. Second Vice President Jack Warner, Jr., in charge of membership, described the purpose and value of AFCEA membership to the many non-member guests present.

Charles LaHar of RCA, past chapter president, introduced the guest speaker, Cyril N. Hoyler, Manager of Technical Relations at the David Sarnoff Research Center, RCA Laboratories, Princeton, N. J., whose subject was "New Adventures in Electronics."

Mr. Hoyler's demonstration-lecture centered in the field of solid-state physics, wherein he included a demonstration of electroluminescense and photoconductivity in connection with an experimental light amplifier. He also demonstrated high speed electronic photography and an experimental miniaturized industrial television camera using a half-inch vidicon and 19 transistors with a total power consumption of less than 5 watts. Another demonstration showed the principles of electronic refrigeration. Mr. Hoyler's program was given an enthusiastic reception and was audience-rated as outstanding in interest and presentation.

Credit for the successful meeting went to First Vice President John Inwood and the members of his Programs and Meetings Committee, namely, James McLean, President of Hoffman Laboratories, Robert Vaughan of RCA and John Atwood of Hughes Aircraft; also to Treasurer Ray Meyers, Secretary Frank Shannon and his secretary Mrs. Helen Selby, and all the other officers and directors who assisted in the various arrangements.

Southern Connecticut

The Southern New England Telephone Company presented a program entitled "Telephone Magic" at the chapter's dinner-meeting on November 14th. The presentation included demonstrations of working models of such advanced electronic equipment as solar batteries, micro-wave transmission, transistorized equipment, etc.

Special guests were John H. Sherwood, Dictaphone Corporation engineer, and his class of thirty men studying radio under the Fairfield, Connecticut, adult education training program.

Tinker-Oklahoma City

Maj. Gen. Gordon A. Blake, Commander, USAF Security Service, and a National Director of AFCEA, addressed the November 14th chapter meeting at Tinker Air Force Base Officers Club. "Student Chapters—AFCEA" was his topic.

In his talk, which was related to the study made by the AFCEA Committee on Student Chapters and Education, which he had chairmanned in 1956, General Blake stressed the need for "young blood" in the communications and electronics career fields. He urged the membership to start a vigorous campaign to assist educators in the motivation of high school and college students to pursue such careers.

General Blake stated that AFCEA chapters must make honest self-appraisals to determine what they can do to stimulate interest in the electronics and engineering fields. He also emphasized the point that an effective student mem-

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Southern California—Shown at the opening meeting of the fall season on November 6th are, left to right: past president, Charles "Larry" LaHar; 2nd vice president, Jack Warner, Jr.; treasurer, Ray E. Meyers; guest speaker, Cyril N. Hoyler; 1st vice president, John Inwood; president, Lester R. Daniels, and secretary, Col. Frank J. Shannon, Sr.

Tinker-Oklahoma City—Maj. Gen. Gordon A. Blake addressed the November 14th chapter meeting at Tinker Air Force Base Officers Club. Pictured left to right, are: Delbert F. Cravens, president; Maj. Gen. Gordon A. Blake, and Col. J. Francis Taylor, Conar Continental AACS Area.

ber program requires close association with both a regular chapter and group members.

"AFCEA could perform an inestimable service to industry, the student, parents and to the national welfare," he said. "Scholarships, contacts with prospective employers, part-time employment in the field of study, a placement service of the first order which starts years before the young man is fully trained, are all fields for study and development by AFCEA chapters."

Washington

A review of military procurement was discussed by John J. Courtney, Special Counsel for the House Armed Services Investigating Committee, at the regular luncheon meeting of the chapter on December 3rd at the Willard Hotel. Mr. Courtney's presentation, from the legislative point of view, was of timely interest because of the imminent change in Congressional attitude toward certain areas of military procurement. Of particular significance were his remarks concerning negotiated procurements which, Mr. Courtney said, continue to be considered as competitive procurements—despite the ill-advised feelings among some of the communications-electronics industry that negotiated procurements are "closed deals" not subject to public scrutiny. "Nothing could be further from the truth," said Mr. Courtney. "There should be publicity, plenty of publicity on these types of contracts." A number of bills currently under consideration and which will be acted upon by the next Congress, will help to clarify the feeling of Government toward negotiated contracts in the light of regularly advertised competitive contracts.

Over 385 members attended the luncheon meeting, which was convened by L. Harriss Robinson, Motorola, as president of the chapter. With him at the head table were: Mr. Courtney; Col. James E. Davoli, USAF, Electronics Branch, Director of Procurement and Production, DCS/MAT; Col. Robert G. Ruegg, USAF, Director of Procurement and Production, DCS/MAT; Capt. Edward M. Fagan, Director, Procurement Division, ONM; Rear Adm. Wellington T. Hines, Assistant Chief of the Bureau of Aeronautics for Procurement, Department of the Navy; Major Gen. Henry R. Paige, Assistant Chief of Staff, G-4, U.S. Marine Corps; William H. Moore, Special Assistant for Procurement, Office of Assistant Secretary of the Navy for Materiel; Courtney Johnson, Deputy Assistant Secretary of the Army for Logistics, Department of the Army; Lt. Col. William W. Thybony, Procurement Division, Office of the Assistant Secretary of the Army for Logistics; Colonel Elmer J. Gibson, Chief, Procurement Division, Office of the Deputy Chief of Staff for Logistics, Department of the Army; Col. Albert Fregosi, Acting Director, Procurement Policy and Regulations, Office of the Assistant Secretary of Defense; Major Gen. James Dreyfus, Chief, Procurement and Distribution Division, Office of the Chief Signal Officer, Department of the Army, and Max Golden, Deputy Assistant Secretary of the Air Force for Procurement and Production.

Washington—John J. Courtney addressed the December luncheon meeting held at the Willard Hotel.

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D-C TELEGRAPH EQUIPMENT

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Communications—Electronics—Photography

Listed below are the firms who are group members of the Armed Forces Communications and Electronics Association. By their membership they indicate their readiness for their share in industry's part in national security. Each firm nominates several of its key employees or officials for individual membership in AFCEA, thus forming a group of the highest trained men in the electronics and photographic fields, available for advice and assistance to the armed services on research, development, manufacturing, procurement, and operation.

Admiral Corp.
Aircraft Radio Corp.
Allied Control Co., Inc.
Allied Radio Corp.
American Cable & Radio Corp.
American Electronic Laboratories, Inc.
American Institute of Electrical Engineers
American Machine & Foundry Co.
American Radio Relay League
American Telephone & Telegraph Co.
American Telephone & Telegraph Co., Long Lines Dept.
Ampex Corp.
Amphenol Electronics Corp.
Anaconda Wire & Cable Co.
A. R. F. Products, Inc.
Arnold Engineering Co.
Atlas Precision Products Co.
Automatic Electric Co.
Automatic Electric Sales Corp.
Automatic Telephone & Electric Co., Ltd.
Autonetics, Division of North American Aviation, Inc.
Barry Controls, Inc.
Bell & Gossett Co.
Bell Telephone Company of Pa.
Bell Telephone Laboratories, Inc.
Bendix Radio Division, Bendix Aviation Corp.
Blackburn Electronic Corp.
Bliley Electric Co.
Bomac Laboratories, Inc.
British Thomson-Houston Co., Ltd.
Bruno-New York Industries Corp.
Burroughs Corp.
California Water & Telephone Co.
Cambridge Thermionic Corp.
Capitol Radio Engineering Institute, Inc.
Carolina Telephone & Telegraph Co.
Central Technical Institute
Chesapeake & Potomac Tel. Co.
Cincinnati & Suburban Bell Tel. Co.
Close Associates, Inc.
Collins Radio Co.
Columbia Broadcasting System, Inc.
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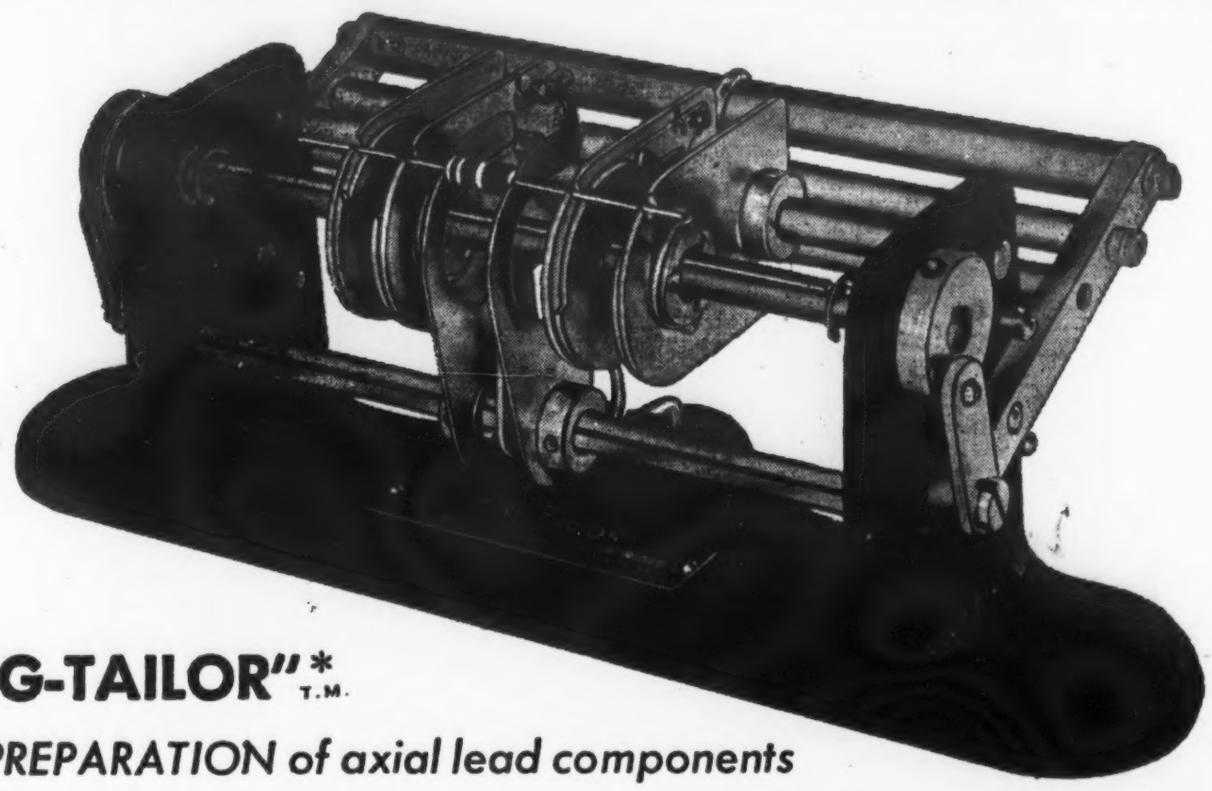
Cornell-Dubilier Electric Corp.
Craig Systems, Inc.
Crosley Division-Avco Mfg. Corp.
Designers for Industry, Inc.
DeVry Technical Institute
Diamond State Telephone Co.
Dictaphone Corp.
DuKane Corp.
DuMont, Allen B., Laboratories, Inc.
Eastman Kodak Co.
Electronic Associates, Inc.
Electronic Communications, Inc.
Elgin Metalformers Corp.
Fairchild Camera & Instrument Corp.
Farnsworth Electronics Co.
Federal Telecommunication Laboratories
Federal Telecommunication Laboratories—West Coast Branch
Federal Telephone & Radio Co.
General Aniline & Film Corp.
General Cable Corp.
General Communications Co.
General Electric Co.
General Telephone Corp.
Gilfillan Bros., Co.
Globe Wireless, Ltd.
Gray Manufacturing Co.
Hallamore Electronics Co.
Haller, Raymond and Brown, Inc.
Hallicrafters Co., The
Haloid Co.
Hazeltine Electronics Division, Hazeltine Corp.
Heinemann Electric Co.
Hitemp Wires, Inc.
Hoffman Laboratories, Inc.
Hogan Laboratories, Inc.
Hoover Electronics Co.
Hopkins Engineering Co.
Hughes Aircraft Co.
Hycon Eastern, Inc.
Illinois Bell Telephone Co.
Indiana Bell Telephone Co.
Indiana Steel & Wire Co.
Institute of Radio Engineers
International Business Machines
International Resistance Co.
International Telephone & Telegraph Corp.
Jacobsen Manufacturing Co.
Jansky & Bailey, Inc.
Kellogg Switchboard & Supply Co.
Kin Tel
Kleinschmidt Laboratories, Inc.
Koiled Kords, Inc.
Lansdale Tube Co., Division of Philco Corp.
Leich Sales Corp.
Lenkurt Electric Co.
Lewyt Manufacturing Corp.
Loral Electronics Corp.
Machlett Laboratories, Inc.
Magnavox Co.
Mallory, P. R., & Co., Inc.
Materiel Telephonique Co.
Michigan Bell Telephone Co.
Montgomery Co., The
Motorola, Inc.
Mountain States Telephone & Telegraph Co.
Mullard Ltd.
Muter Co.
Mycalex Corporation of America
National Co., Inc.
Nelson Technical Enterprises
Nems-Clarke, Inc.
New England Tel. & Tel. Co.
New Jersey Bell Telephone Co.
New York Telephone Co.
North Electric Co.
Northwestern Bell Telephone Co.
Oak Manufacturing Co.
Ohio Bell Telephone Co.
O'Keefe & Merritt Co.
Otis Elevator Co., Electronic Division
Pacific Mercury Television Mfg. Corp.
Pacific Telephone & Telegraph Co.
Packard-Bell Co.
Page Communications Engineers, Inc.
Phelps Dodge Copper Products Corp.
Philco Corp.
Photographic Society of America
Plessey Co., Ltd.
Prodelin Inc.
Production Research Corp.
Radiart Corp.
Radio Corporation of America
Radio Corporation of America, Defense Electronic Products
RCA Great Britain, Ltd.
Radio Engineering Laboratories, Inc.
Ramo-Wooldridge Corp.
Raytheon Manufacturing Co.
Red Bank Division, Bendix Aviation Corp.
Reeves Instrument Corp.
Remington Rand, Division of Sperry Rand Corp.
Remler Co., Ltd.
Rocke International Corp.
Saxonburg Ceramics
Society of Motion Picture & Television Engineers
Sonotone Corp.
SoundScriber Corp.
Southern Bell Telephone & Telegraph Co.
Southern New England Telephone Co.
Southwestern Bell Telephone Co.
Sperry Gyroscope Co., Division of Sperry Rand Corp.
Sprague Electric Co.
Stackpole Carbon Co.
Standard Telephone & Cables, Ltd.
Stanford Research Institute
Stelma, Inc.
Stewart-Warner Corp.
Stoddart Aircraft Radio Co.
Stromberg-Carlson Co., Division of General Dynamics Corp.
Surprenant Mfg. Co.
Sylvania Electric Products, Inc.
Technical Materiel Corp., The
Tele-Dynamics, Inc.
Telephonics Corp.
Teletype Corp.
Tensolite Insulated Wire Co., Inc.
Texas Instruments, Inc.
Times Facsimile Corp.
T.M.C. (Canada) Ltd.
Trad Electronics Corp.
Transitron Electronic Corp.
Triad Transformer Corp.
Tung-Sol Electric, Inc.
Union Carbide Corp.
United Telephone Co.
United Transformer Co.
Waterman Products Co., Inc.
Webster-Chicago Corp., Government Division
West Coast Telephone Co.
Western Electric Co., Inc.
Western Union Telegraph Co.
Westinghouse Electric Corp.
Weston Electrical Instrument Corp.
Wheelock Signals, Inc.
Wickes Engineering & Construction Co.
Wilcox Electric Co., Inc.
Willard Storage Battery Div., Electric Storage Battery Co.
Wisconsin Telephone Co.
Wollensak Optical Co.
Zenith Radio Corp.

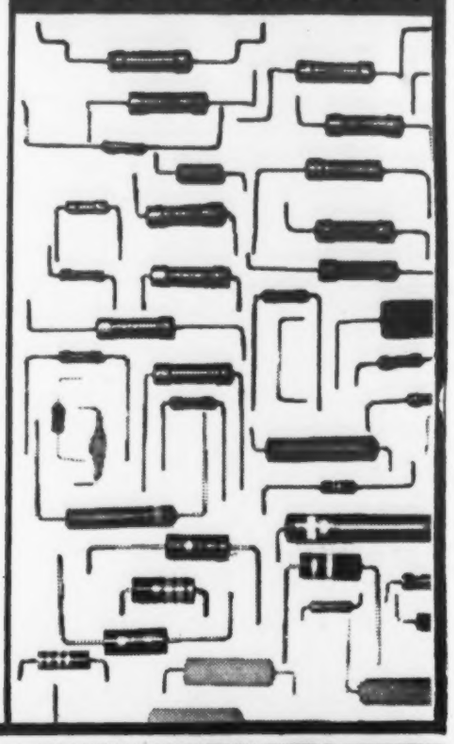
PROVEN-on the assembly line!



"PIG-TAILOR"* T.M.

For PREPARATION of axial lead components

PREPARED COMPONENTS IN SECONDS WITH THE "PIG-TAILOR"



"PIG-TAILORING"

. . . . a revolutionary new mechanical process for higher production at lower costs. Fastest PREPARATION and ASSEMBLY of Resistors, Capacitors, Diodes and all other axial lead components for TERMINAL BOARDS, PRINTED CIRCUITS and MINIATURIZED ASSEMBLIES.

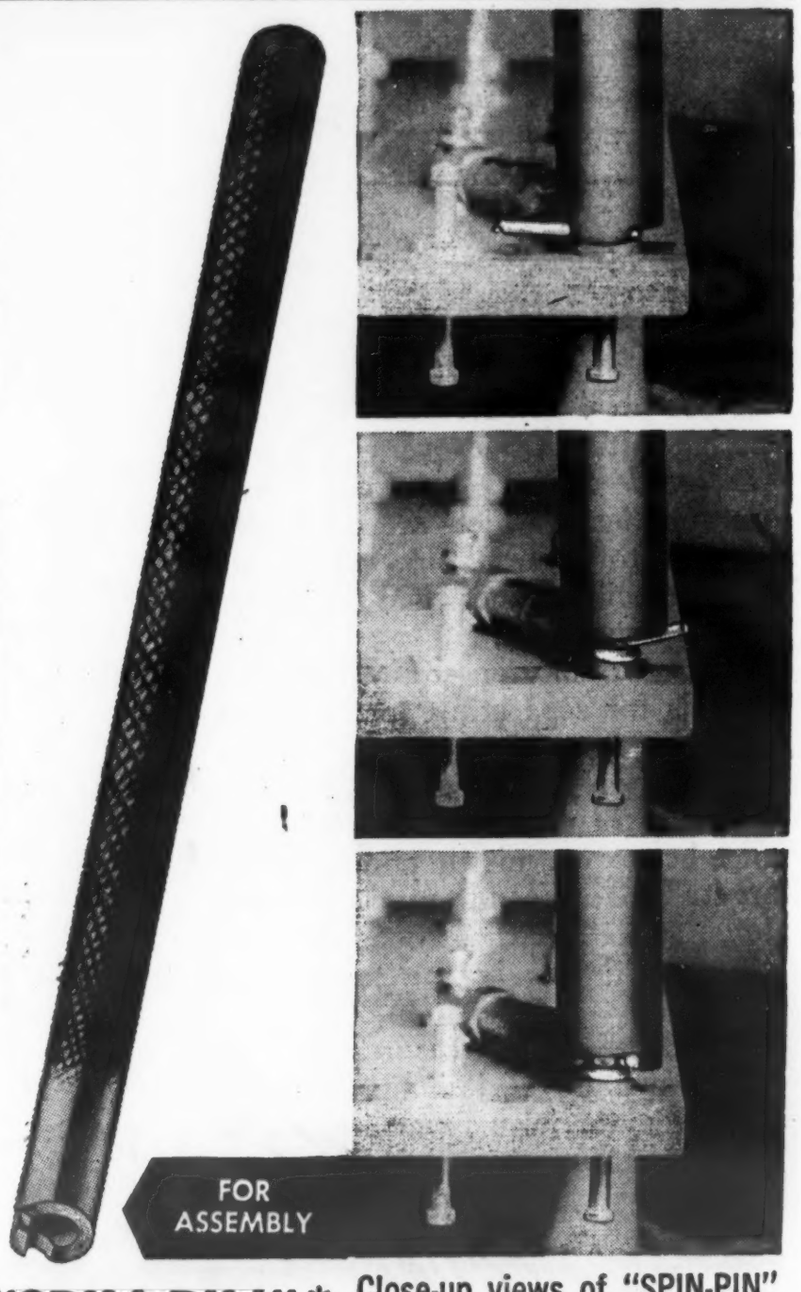
The "PIG-TAILOR" plus "SPIN-PIN"—accurately MEASURES, CUTS, BENDS, EJECTS & ASSEMBLES both leads simultaneously to individual lengths and shapes—3 minute set-up—No accessories—Foot operated—1 hour training time.

PIG-TAILORING provides:

1. Uniform component position.
2. Uniform marking exposure.
3. Miniaturization spacing control.
4. "S" leads for terminals.
5. "U" leads for printed circuits.
6. Individual cut and bend lengths.
7. Better time/rate analysis.
8. Closer cost control.
9. Invaluable labor saving.
10. Immediate cost recovery.

PIG-TAILORING eliminates:

1. Diagonal cutters!
2. Long-nose pliers!
3. Operator judgment!
4. 90% operator training time!
5. Broken components!
6. Broken leads!
7. Short circuits from clippings!
8. 65% chassis handling!
9. Excessive lead tautness!
10. Haphazard assembly methods!



"SPIN-PIN"* T.M. Close-up views of "SPIN-PIN" illustrate fast assembly of tailored-lead wire to terminal.

* PATENT PENDING

Write for illustrated, descriptive text on "PIG-TAILORING" to Dept. S-1P

BRUNO-NEW YORK INDUSTRIES CORPORATION

DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT

460 WEST 34th STREET • NEW YORK 1, N. Y.

ITEMS OF INTEREST

From Government, Industry and the Services

75 Electronic Problems

Seventy-five problems in electronics are among the 387 inventions wanted by the Government. This information was contained in a list of needed inventions recently published by the National Inventors Council.

Acting as an exchange for the solution of technical problems by industry for the Government, the Council printed a previous list in 1954. Approximately 25% of these prob[illegible] were solved and a greater numbe[illegible] expected this year.

The magnetic mine detector and the mercury dry cell battery are among the more successful resultant inventions. Also notable: the principle of "toss bombing" (submitted as early as World War II), and ideas on in-flight refueling which, when coordinated by the NIC, led to use of jet trainers in the Strategic Air Command.

Some of the needed inventions are listed below.

Infrared Detector — with higher sensitivity and faster response time than are presently available for wave lengths up to 14 microns.

Infrared Sensors — infrared sensors and heads which are unusually sensitive to several selected bands of frequencies, rather than the entire infra-red spectrum.

Radar Resolution of Targets — methods for separating each aircraft in a close formation.

Electronic Miss-Distance Systems —which will determine the miss-distance between a missile and an aerial target. Those depending on reflection alone, as well as those depending on a second device in the target, are needed.

Counter-Countermeasures — successful method of jamming a radar set include: noise jamming, C W jamming, pulse jamming, chaff, spoofing and artificial glint. Methods for combating these are needed.

Radar Cluttter Rejection—a clutter rejection system for pulse radars.

New Methods of Converting Light Energy Into Electrical Energy—silicon solar converter is promising. But so far, no efficient, cheap, compact converter of light to electrical energy has been developed in the 100 w plus range. Converter should have a constant current output and good voltage regulation, be rugged, and operate in temperatures ranging from —65 F to 185 F.

"Inventions Wanted by the Armed Forces," in booklet form, is available without charge from the National Council of Inventors, U. S. Department of Commerce, Washington 25, D. C.

Longest Contact With Satellite

What is believed to have been the longest continuous contact with the Soviet earth satellite was reported by Army soldier scientists on a desolate ice island near the North Pole.

Their radio monitored the sphere for more than 13 hours on successive days as it circled the earth. At other spots throughout the world, the satellite's radio signal could ordinarily be picked up only for about a half hour at a time as the space vehicle passed nearby.

The outpost's unique position is credited by scientists for the greatly extended reception. The station is located on Fletcher's Ice Island, a 10-mile-long fragment of shelf ice in the Arctic Ocean about 450 miles from the North Pole.

The satellite's radio signal, the scientists reason, must have come down from space and ricocheted several times between the earth's surface and the under side of the ionosphere like a pool ball between two opposite cushions. There are few spots in the world where such "ducting" could have occurred to bring the signal in consistently.

The soldiers were on the island to make special studies of communications near the Pole for the U.S. Army Signal Radio Propagation Agency at Fort Monmouth, N. J.

TEW System

Promising to extend radically the Nation's tactical defense perimeters, a new, highly portable, tactical early warning (TEW) system is being developed by Sperry Gyroscope Co. for the U. S. Marine Corps.

The long-range, search and height-finding radar system will detect close-in or distant high-speed enemy aircraft and missiles. Designed to satisfy the Marines' particular requirement for helicopter transportable equipment, the lightweight system is adaptable to rapidly changing tactical situations in any environment.

First of comparable size and weight to provide three-dimensional data at extreme ranges, the AN/MPS-21 radar system can be transported quickly and may be brought into battle-area operation within a two-hour period.

The device, using miniaturized components, is about one quarter the size and weight of conventional radar systems, yet has extended the detection range and accuracy to pick up missile-like supersonic targets at extreme distances. The equipment also is capable of highly accurate height determination to its maximum detection range. By incorporating detection and height determination, this equipment is capable of replacing two present radar systems.

Its dome-like shelter, designed by Birdair Structures, Inc., Buffalo, N. Y., resembles in appearance the permanent radomes used on the famous DEW line. The transportable MPS-21, however, uses an inflatable, dual wall, air-mattress-like radome. It, like the system itself, is designed for use in climates ranging from the tropics to the arctics; the radome is cooled or heated as needed.

Douglas Thor

Reports from Douglas Aircraft Company, Inc. indicate that the *Thor* has a record of successful firings far in excess of the 1500-mile range for which it was designed and has risen higher than Sputnik I.

Developed for the U.S. Air Force and built with production tooling, the Intermediate Range Ballistic Missile is said to be ready for mass production. It is able to strike anywhere in the world from U.S. bases.

Douglas has produced 19,000 missiles of all types and has been engaged in the design and production of missile systems and their support equipment for the Army, Navy and Air Force since before World War II. This includes air-to-surface, air-to-air, surface-to-air and surface-to-surface systems.

Douglas reports that much of the development in the missile field has been based on information derived from units they have already produced.

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The 1958 IRE Convention and Show will be the source of new ideas for more than 50,000 radio engineers. Be sure you are there.

MARCH 24-27

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Waldorf-Astoria Hotel
and The Radio Engineering Show
Coliseum
New York City

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PRODUCTION
INSTRUMENTS AND COMPONENTS
COMPONENT PARTS
SYSTEMS

I R E

THE INSTITUTE OF RADIO ENGINEERS 1 East 79th Street, New York 21, N.Y.

ITEMS OF INTEREST

Raytheon Building

Raytheon Manufacturing Company's Missile Systems Division headquarters now occupies a recently completed 40,000-square-foot office and laboratory building in the Waltham Industrial Park near Boston.

The company is prime contractor, with complete systems responsibility, for both the Army Hawk and the Navy Sparrow III missiles.

"Twistor"

Exploratory work by A. H. Bobeck at Bell Telephone has resulted in the "Twistor," a new concept in memory devices. The development is expected to make possible memory systems which are simpler to fabricate and more economical to manufacture than existing systems.

Such devices may have extensive applications in computers and electronic switching systems where rapid-access, high-capacity memories are necessary.

The "Twistor" concept is said to have opened the way for the construction of magnetic memory arrays by merely interweaving horizontal copper wires and vertical magnetic wires, much as window screen is woven. It would be similar in appearance to ferrite core array, but without the cores, and would operate in much the same manner.

This development derived the name "Twistor" from a wire made of magnetic material characteristic. Torsion applied to such a wire shifts the preferred direction of magnetization from longitudinal to a helical path. The coincidence of a circular and a longitudinal magnetic field can then be used to insert information into this wire in the form of a polarized helical magnetization and the magnetic wire itself can be used as a sensing means.

Present indications are that the drive circuits for a "Twistor" array can be readily transistorized. Thus, a memory system using the "Twistor" concept will be much simpler and more economical to fabricate while retaining all of the advantages of ferrite core or sheet systems.

Heat Into Electricity

The development of a means of generating electricity through direct conversion of heat energy has been announced by General Electric.

Developed by Dr. Volney C. Wilson, the new thermionic converter is based on the fact that electrons can be "boiled out" of a hot metal surface and used to produce an electric current directly.

According to Dr. Guy Suits, GE vice president and director of research, advantage of the new system is that it creates a mechanism for production of electricity that has no moving parts. Elimination of moving parts would remove wear created by friction in present generators.

Still in the laboratory stage, the device at present operates at 8% efficiency. Dr. Suits said it is too early to predict to what applications the discovery might be put.

In the new development, two pieces of metal are enclosed in a tube-like device, separated by a gas at low pressure. One of the pieces of metal is then heated to a point where electrons will pop off its surface, much in the same manner that steam bubbles escape from boiling water.

The freed electrons are then attracted to the other metal bar, which is kept at a temperature well below the heated element. An electric current is created by drawing the electrons from the cooler terminal along a wire.

Names in the News

Ray Meyers, new AFCEA regional vice president for Region "F," recently received a certificate of appreciation from the Veterans of Foreign Wars, District of California, in recognition of his "outstanding service to the city of San Gabriel, California, through his unselfish devotion of time and energy to the Civil Defense Communications Division of that city." Mr. Meyers also holds the "International Gold Medal Award" which was presented for the most outstanding work in radio for the year 1931.

Donald S. Parris has been named Director, Electronics Division, Business and Defense Services Administration, Department of Commerce. Mr. Parris was placed in charge of the Electronic and Communications Equipment Division of NPA when it was established in 1950, and in 1953 he became Acting Director of the Electronics Division of BDSA.

Colonel Glenn S. Meader has assumed command of the Los Angeles Regional Office, USA Signal Supply Agency at Pasadena, California. He recently returned from an overseas assignment where he served as Signal Officer, U. S. Army Pacific at Fort Shafter, T.H. and Joint Communications Officer, Hawaii Defense Command. Colonel Meader served as 1956-57 president of AFCEA's Hawaii chapter.

John W. Luke has been appointed Assistant Manager of Marketing for International Business Machines Corporation's Military Products Division. In his new assignment he will assist in customer relations, marketing and future product planning.

John B. Jackson has been named as the Washington, D. C., representative for IBM's Military Products Division. He will assist in maintaining liaison between the Division's operating facilities and various Government agencies.

Donald G. Fink, Director of Research of the Philco Corporation, has been elected president of the Institute of Radio Engineers for 1958. He succeeds **John T. Henderson**, Principal Research Officer of the National Research Council, Ottawa, Canada. **Carl-Eric Granqvist**, Director of Svenska Aktiebolaget Gasaccumulator, Stockholm-Lidingo, Sweden, will succeed **Yasujiro Niwa**, President of Tokyo Electrical Engineering College, Tokyo, Japan, as IRE vice president.

J. Edwin Boughtwood and **F. Beaumont Bramhall**, Western Union engineers, have been honored with the 1957 d'Humy Medal for their research, basic inventions, development and application of FM carrier to commercial telegraphy. The d'Humy Medal was established in 1956 by Western Union in recognition of the achievements of the late **Fernand E. d'Humy**, Vice President and Director of the company.

Dr. C. D. W. Thornton has been appointed Director of Research and Development of Farnsworth Electronics Co. of Fort Wayne, Indiana. Dr. Thornton has been serving this division of IT&T as Director of Research since September, 1956.

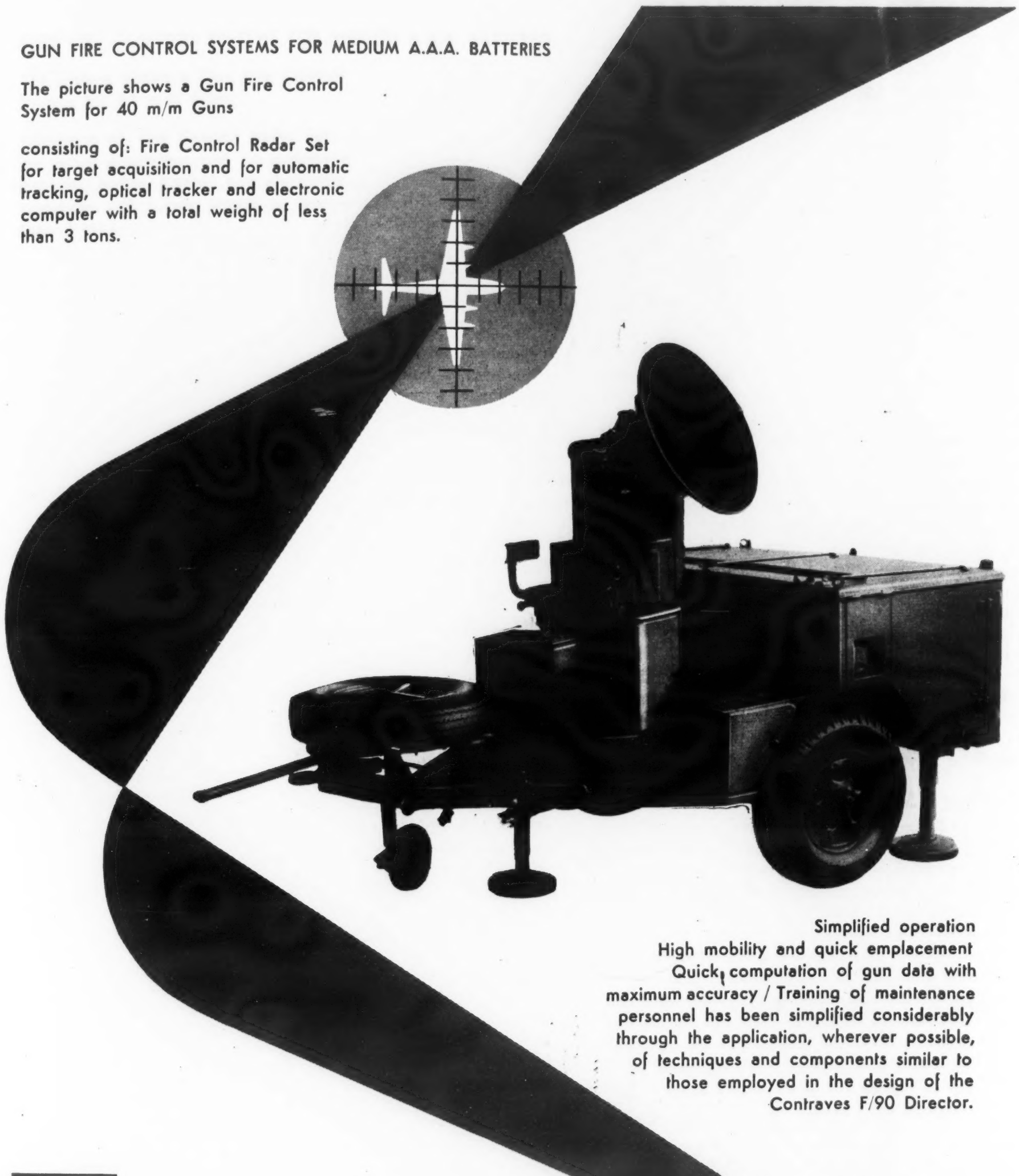
Dr. Margaret C. Arst, Ph.D., has been appointed to the expanded Research & Development staff of Hoffman Semiconductor Division of Hoffman Electronics Corporation. Dr. Arst will concern herself with basic solid state physics research as applied to silicon semiconductor devices.

We are all looking forward to **Rear Admiral Joseph N. Wenger's** return to active duty following a recent illness and are glad his improvement has been steady.

GUN FIRE CONTROL SYSTEMS FOR MEDIUM A.A.A. BATTERIES

The picture shows a Gun Fire Control System for 40 m/m Guns

consisting of: Fire Control Radar Set for target acquisition and for automatic tracking, optical tracker and electronic computer with a total weight of less than 3 tons.



Simplified operation
High mobility and quick emplacement
Quick computation of gun data with maximum accuracy / Training of maintenance personnel has been simplified considerably through the application, wherever possible, of techniques and components similar to those employed in the design of the Contraves F/90 Director.

GARRETTO

CONTRAVES ITALIANA S.p.A. ROMA

NEW PRODUCTS FROM INDUSTRY

Fastest Processing of Computer Data

A joint program undertaken by Stromberg-Carlson of San Diego 12, Cal., and The Haloid Co. of Rochester 3, N. Y., has resulted in the development of the world's fastest print-out equipment for acceleration of electronic processing and printing of computer data.

Combining Stromberg-Carlson's charactron shaped beam tube and Haloid's xerox copyflo printer, the new product achieves, without high-speed moving parts, an output of 4,680 lines per minute—5 to 10 times faster than the speed of present electro-mechanical printers.

Claimed to require relatively low cost of operation, the "S-C 5000" can be used in both the on-line method of receiving electronic data direct from the computer, and the off-line method of receiving the data from magnetic tape. For some applications, along with the printing device there will be supplied an editing and control device which provides a means of giving directions to the printing machine to control its operations, tailoring it to the individual requirements of any applications.

8-Hour "Soundbook"

Up to 8 hours of uninterrupted recorded music, said to compare in quality to hi-fi recording, is now possible with the new miniaturized tone reproducer unit developed recently by the Tefifon-Company of Germany.

Exclusively distributed here by Audio-Master Corp., 17 E. 45th St., N. Y., the unit utilizes a new engraved soundreel principle, which enables a continuous play of recorded music. This unbreakable vinyl soundband, referred to as "soundbook," resembles in size an average pocketbook edition. Approximately ½" wide, it contains an average of 92 grooves. Its plastic container allows the self-contained unit a weight of less than a pound.

Easy operation for change of reel resembles the method in which a phonograph record is put on a turntable.

Presently, there are available some 55 soundbooks offering a variety of musical entertainment, readings of poetry and drama, and lectures. Tefifon-Company, however, releases additional new soundbooks each month.

Versatile Speedvolter

The speedvolter, a precision instrument offering quick and accurate means of measuring speed, has been specially developed by Servo-Tek Products Co., 1086 Goffle Rd., Hawthorne, N. J., to satisfy the needs of industry and laboratories, and to enable technicians to trouble-shoot equipment by means of voltage and resistance checks.

Particularly adapted for use in measuring the speed of motors, rotating machinery, conveyor belts, etc., the versatile tester also serves as a high quality voltmeter and ohmmeter with good sensitivity and accuracy on all ranges.

An outstanding feature of the instrument is the unusual method by which both meter and circuits are protected so that burn-outs are virtually impossible.

3-Axis Flight Simulator

A 3-axis flight simulator, with applications in development and production testing of inertial, infra-red, electronics, or acoustical guidance and control systems, has been developed by Aircraft Armaments, Inc., of Cockeysville, Md.

A lateral clearance of 5 feet was allowed about the test unit for external equipment and it is capable of unlimited motion about any axis.

Each gimbal is driven by a high performance hydraulic servo system, in response to signals from an analog computer. Synchros are used for error sensing in the closed servo loop, and a high gain amplifier drives a spool-type servo valve for hydraulic motor control. Hydraulic and electric lines are fed by means of slip rings on each axis.

The gimbal structure was designed with mechanical resonant frequencies above 20 cps and with minimum moments of inertia compatible with these frequencies. These high natural frequencies provide a servo response that is flat out to 4-8 cycles, depending upon the axis considered.

"Image-Converter" Tube

High-speed multiple-frame photography, with exposures as short as a 100-millionth of a second, is reported possible through the use of a new "image-converter" tube, a development of the Electron Tube Division of RCA.

Operating principles of the image converter for speed photography are said to be simple, employing electrostatic focusing, a grating grid that acts as a shutter, and a deflection system claimed to produce as many as 5 separate screen images simultaneously.

Electron beam energy is converted on the phosphor screen into actinic radiation. The screen, prepared with a very fine grain phosphor, has an aluminum backing to increase light output. Under normal operating conditions, it is claimed that the tube provides an increase in radiant energy from the screen by as much as 24 times the energy incident on the photocathode.

New Precision Instrument

A unique-type precision instrument, capable of anticipating bearing failures in rotating machinery, has been developed by Lycoming Division, Avco Manufacturing Corp.

The "temperature acceleration indicator" acts as an electronic sleuth by detecting acceleration of temperature rise in such units as jet engines, steam turbines, electrical generators, gasoline engines, helicopter transmissions and gear boxes and by anticipating the development of a condition dangerous to the bearing. Normally, a bearing failure during testing results in the destruction of the apparatus. Consequently, it is believed the indicator will allow for substantial material savings.

The instrument has applications for aviation, industrial and automotive development fields.

Ultraviolet Flying Spot Microscope

A new device allowing observation of living cells continuously for extended periods of time (up to 9 hours or more), and, through the use of lapsed time motion picture techniques, to record on film the slow changes and movements which occur within the cells, has been developed by the Philco Corp. of Philadelphia, Pa., in collaboration with Southwestern Medical School.

In its basic form, the new microscope makes use of a 2-inch cathode-ray tube to employ magnetic deflection and focusing to produce a ras-

ter. The tube's phosphor emits ultraviolet energy having a wavelength of approximately 2600 angstrom units. This raster is then projected through a microscope to produce a reduced and sharply focused raster on the specimen.

The energy emerging from the cell is fed to a device known as a monochromator and then converted to an electrical signal by a specially developed photo-multiplier tube.

Finally, the electrical signal is amplified by conventional methods and utilized to excite a cathode-ray tube similar to a TV picture tube, employing, however, a long-persistence phosphor.

The new device is believed to provide a striking illustration of the benefits to be gained from the uniting of electronics with other sciences.

Remote Preset Counting Unit

Featuring a provision for the presetting of numbers from a remote location, the Model 101AR remote preset decade counting unit has been developed by Computer Measurements Corp., 5525 Vineland Ave., N. Hollywood, Calif., for the application of preset counters and controlling equipment.

Model 101AR's control is accomplished by the use of a 5-wire cable terminating in a small 5-pin plug. Extending the cable to a reasonable distance, one may use the simple switch at the end to select any digit from 0 to 9. Actuating voltage can be from 6 to 24 volts, DC. Substitution of the remote counting unit for 101AR preset units is possible in all CMC preset controlling instruments.

Designed to provide an output pulse at a selected number of rates in excess of 40,000 counts per second, this direct reading Model 101AR can, if reset is not required, count at a 100,000 cps rate. Readily connected in cascade, the unit can emit a pulse at any desired count.

Among typical applications are batching, sorting, packaging, automatic counting and controlling, frequency division and generation of precise delays.

Hi-Fi Device Detects Heart Whispers

An ultra-sensitive pickup using principles of high fidelity to pick up faint heart whispers for human hearing and to record them for diagnostic studies has been developed by medical scientist Dr. Dale Groom of the Medical College of So. Carolina, and General Motors engineer Yro T. Sih-

Prodelin G-LINE
NOW AVAILABLE
UP TO 9000 MC!

New Surface Wave Transmission Line

- Transportation Economy
- Installation Economy
- Maintenance Economy

...with No Loss in Performance Characteristics

The Prodelin G-Line assembly is a surface wave transmission line for use in commercial or military service up to 9000 mc. It replaces conventional waveguide or coaxial transmission lines and permits transportation, installation, and maintenance at lower costs than ever before possible.

The Prodelin G-Line is terminated at both ends by identical RF field transformer sections which provide an efficient transition from a conventional feed line to the surface wave wire and back again at the antenna input end.

- Lowest wind loading of any line available
- No elbows, bends, or complicated plumbing to install
- No pressurization required

Hundreds of Prodelin G-Line systems are already operating successfully. Learn how G-Line can lower your shipping, installation, and maintenance costs while delivering superior performance characteristics. Manufactured for antenna application under exclusive U.S. license.

WRITE TODAY!

ANTENNAS and TRANSMISSION LINES
Prodelin Inc
KEARNY, NEW JERSEY, U.S.A.

Dept. S 307 Bergen Avenue Kearny, N. J.

vonen of Detroit.

The new device records from the chest surface the faint sounds not otherwise detectable without actually going into the heart with miniature microphones.

Basically different from those devices previously used to detect and distinguish heart sounds, this new pickup detects the sound vibrations directly from the skin, eliminating the losses of fidelity and sensitivity that occur whenever sound passes from a dense medium (the body) to a rare medium (air).

Sound Waves Provide "Sight"

"Hear-a-light," a battery-operated electronic device which permits the blind to distinguish between various objects and substances by means of sound waves, has been developed by the Bell Aircraft Corp., Washington, D. C.

Resembling a fountain pen, the device contains a sensitive photo-cell and an electric oscillator, connected by wires to an earpiece. A steady tone transmitted to the ear varies in pitch with the intensity of the light to which the device is exposed.

At a recent demonstration, it is said a blind person was easily able to distinguish salt from pepper by the sound tone created by the light reflected through the glass container.

Closed-Circuit TV Camera Self-Contained

A single unit, closed-circuit, TV camera with an associated remote-control box which permits camera operation from distances up to one mile away, has been developed by General Precision Labs., Inc., 63 Bedford Rd., Pleasantville, N. Y.

Designated GPL Model PD-500, the vidicon camera weighs 12 pounds and is completely self-contained within the camera housing. The remote-control box is available as an accessory.

New Literature

Printed Circuit Soldering Manual

Claimed to be an excellent technical study, a new 12-page booklet entitled "Printed Circuit Soldering" is now available at no cost from Kester Solder Co., 4201 Wrightwood Ave., Chicago 39, Ill.

The booklet offers description of the types of fluxes suitable for printed circuit soldering, and additional material concerning temperatures, procedures, alloys and contaminations is also included.

"Transistor Applications, Vol. II"

A second volume carrying the title, "Transistor Applications," has been published by Raytheon Manufacturing Co., 55 Chapel St., Newton 58, Mass., and may be obtained at the price of 50¢.

Offering a more general coverage than the previous volume, the new 8½ x 11-inch book includes hints on lab. techniques, shop practice and basic transistor theory. Discussion of construction articles on radio receivers, ham equipment, home broadcasters, burglar and fire alarms is given together with treatment of printed circuits, use of sun batteries and wiring precautions.

Radiochemical Techniques Bulletin

Nuclear Science & Engineering Corp., P.O. Box 10901, Pittsburgh 36, Pa., is offering at no cost a new 4-page bulletin, designated #408, describing the many applications of radiochemistry in order to obtain difficult technical engineering data.

Radiochemistry, which combines radioactivity measurements in conjunction with chemical determinations, is explained and successful case histories are cited.

Univac II Manual

An ideal beginning for those planning to make a thorough exploration of electronic data processing can be had with the new 196-page, illustrated manual, "A Study for Management—The Univac II Data Automation System (U1352)," and is obtainable, free of charge, from Remington Rand Univac, 315 Fourth Ave., New York 10.

Material is based on the collective experience of Univac specialists who have, since Univac's installation in 1951, trained the management and operating personnel.

Selection of equipment, various applications, selection and training of personnel, the conversion to an electronic system, preparation of the computer program (a complete introductory course suitable for classroom use)—all areas of importance in the management field are treated in detail.

New Improved
POLAR RECORDER
For Antenna Pattern Measurements Featuring New Plug-in Potentiometers.
SPECIFICATIONS
Scientific-Atlanta antenna pattern recorders are precision instruments for automatically recording signal strength as a function of antenna position. Measurement is both rapid and accurate. The Series 122 Recorders have the following specifications:
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• writing speed: 40 inches per second (maximum);
• response: choice of linear, logarithmic and square-root or any combination;
• accuracy for linear response: ± 0.3% of full scale over entire range;
• accuracy for logarithmic response: ± 0.2 db over entire range of 40 db;
• accuracy for square-root response: ± 0.5% of full scale over first 20 db, ± 1% over next 20 db range;
• sensitivity: 1, 10 and 500 microvolts give full scale deflection for linear, square-root and logarithmic responses respectively.
CHART SYSTEM
• drive system: servo controlled from control transformer geared with turntable;
• speed: 10 rpm maximum;
• position accuracy: better than 0.05° static and 0.5° at 1 rpm.
PRICES:
Model 122B-S36 Linear $3,100
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Model 122B-2-S36 Linear-Square Root-Logarithmic 4,100
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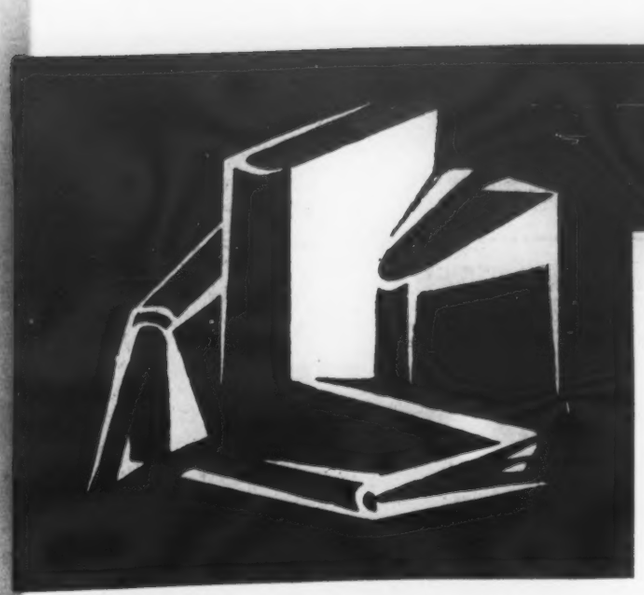

Books

DEW LINE, by Richard Morenus. Rand McNally & Co., New York. 184 pages, $3.95.

Based upon factual data received through the closest cooperation of the Armed Services, *DEW Line* portrays, with vivid descriptiveness, the growth of a miracle of defense.

The story ranges from the initial period of planning in 1952, from the building of an experimental span across the Arctic shore of Alaska, to the completion of the impregnable 3,000-mile radar installation that spans the northernmost reaches of the North American Continent, thus allaying the dangers of large-scale attack across that region with 4 to 6 hours of warning.

Indeed a tribute to the Bell System, Western Electric Co., our Armed Forces and the Royal Canadian Air Force, Mr. Morenus' book gives a dramatic picture of the arduous task of flying in personnel and equipment to build these stations in subzero temperatures during the long Arctic nights.

A SECOND SURVEY OF DOMESTIC ELECTRONIC DIGITAL COMPUTING SYSTEMS, by M. H. Weik. Office of Technical Services, Dept. of Commerce, Washington 25, D. C. 439 pages, $7.00.

The Army's new report, authored by Mr. Weik of the Ballistic Research Labs, Aberdeen Proving Ground, offers a complete coverage of the engineering and programing characteristics of 103 commercially available digital computing systems. The publication supercedes an earlier one prepared in 1955.

An excellent guide for potential users of such equipment, the work provides material concerning applications, cost, personnel requirements, and power and space requirements for specific systems. Reliability problems are treated and suggestions are offered on modifications and improvements useful to those presently operating digital systems. Also included is a glossary of computer engineering and programing terminology.

THE MAKING OF A MOON: THE STORY OF THE EARTH SATELLITE PROGRAM, by Arthur C. Clarke. Harper & Bros., New York. 205 pages, $3.50.

The development of a shiny magnesium rocket to circle the earth at 5 miles per second at a height of 200 to 1500 miles is, without doubt, the most exciting scientific project since World War II.

Mr. Clarke—a founder and former chairman of the British Interplanetary Society—provides in his timely work a thorough explanation of the construction, contents and eventual launching of our satellite along with a statement of the expected contributions to our knowledge of the earth, solar system and universe.

The possibility of using satellites as radio and TV relays and as space stations is discussed together with the legal and military problems inevitably to be raised by man's venture into space. "From a military point of view," Mr. Clarke writes, "(it) could pay for itself after a few revolutions, particularly if it were launched at a moment when it was essential to observe the movements of a potential enemy."

Already cited by *The Wall Street Journal* as the best selling book of its kind since the advent of Sputnik, *Making of A Moon* combines authoritative information with skillful presentation.

THE DAGUERREOTYPE STORY, by Floyd Edward Bliven. Vantage Press, Inc., New York. 45 pages, $2.50.

Louis Jacques Daguerre, French scientist and well-known in the 1820's for his invention of the diorama and his experiments with lighting effects, spent a slowly fruitful lifetime in the experimental work that was to give birth to photography.

Tracing photo development from the 16th century, through the triumph of Daguerre in the mid-nineteenth century, to the later contribution made by America's Hamilton Smith of the cheaper process, tintype, Mr. Bliven provides an engaging account of the progression of thought and development which pioneered the way to photograhpy as we know it today.

A section given to an interesting group of reproductions of some rare daguerreotypes and tintypes gives the reader an authentic portrayal of visual America prior to the Civil War.

STEREOPHONIC SOUND, by Norman H. Crowhurst. John F. Rider Publisher, Inc., New York. 128 pages, paper bound, $2.25.

In assessing the highly controversial subject of stereophonic sound which is credited with having given hi-fi a new dimension, Mr. Crowhurst has joined no individual camp of worshippers in his objective exposition regarding system components.

Trained as an engineer, the author provides a substantial background of history and theory, discusses the listening value and describes the various systems both available and yet to come. Exposition of such systems as binaural, 2 and 3-channel stereophonic, stereosonic and coded-stereophonic includes a treatment of their use with radio, disc, tape and other media. In addition, this information is applied to selection and placement of speakers for the best stereo reproduction in the home.

Among the many topics providing the reader with a complete background are examination of the recording procedure and of the techniques of stereo systems for movie theaters.

QUEST FOR A CONTINENT, by Walter Sullivan. McGraw-Hill Book Co., Inc., New York. 373 pages, $5.50.

Placing emphasis on the more timely efforts in Antarctica, Mr. Sullivan, *New York Times'* distinguished correspondent, shapes his vivid narrative style into a gripping description of his own experiences and observations on 3 expeditions; briefly scans those explorations previous to 1939, highlighting lesser known facts; discusses the present preparations concerned with the IGY, treating fast-approaching questions such as UN control in settlement of ownership and theories regarding eventual fertility.

Claimed the first authorative account of the last 4 expeditions to Antarctica, the book describes the trial of the *U.S.S. Merrick*, trapped in pack ice; the submarine *Sennet's* rescue by the Coast Guard icebreaker; the feats of Operation Windmill, which first introduced the helicopter as a vehicle of exploration, and the cruise of the *U.S.S. Atka* which, in 1955, discovered that half of "Little America" had broken off the continental ice sheet and had floated out to sea.

Ice terminology employed in the work is that which has recently been agreed upon by the World Meteorological Organization.

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The soldier you see carries the new RCA one-pound, postcard-size ultra-miniaturized TV camera connected to a miniature TV transmitter on his back. Concealed in his helmet is a complete radio receiving-transmitting set weighing only a few ounces. He is one of several similarly equipped men covering the battle area from a number of positions in the air and on the ground.

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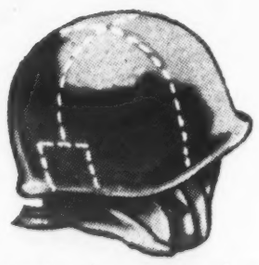

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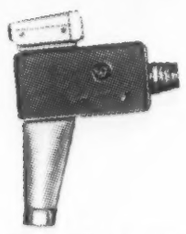

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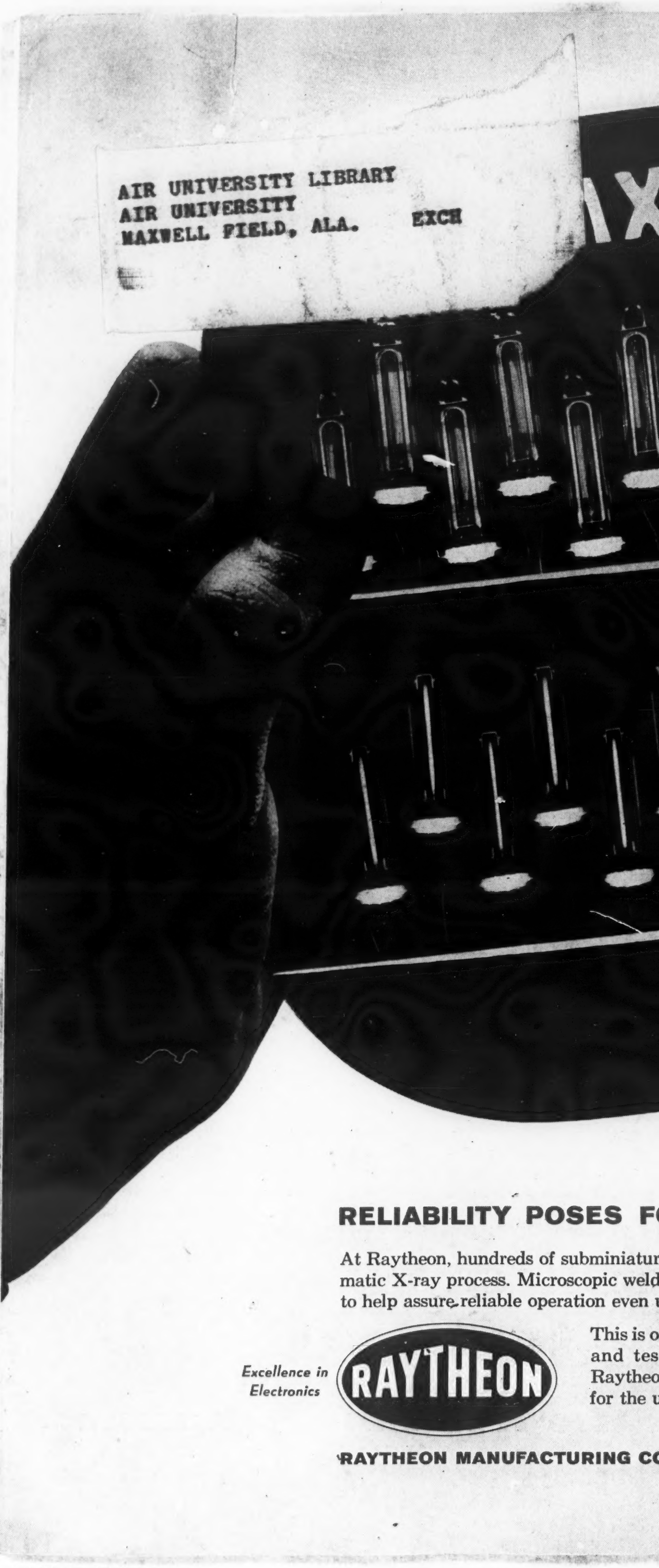

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